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VOLUME VI

REVISED
REMEDIAL INVESTIGATION REPORT
JASCO CHEMICAL CORPORATION
MOUNTAIN VIEW, CALIFORNIA

APPENDIX J - POTENTIAL CONDUITS INVESTIGATION
APPENDIX K - AERIAL PHOTOGRAPHS, JUNE 1952 AND SEPT. 1988
APPENDIX L - BASELINE RISK ASSESSMENT

Prepared by:
OHM Remediation Services Corp.
Sacramento, California

On behalf of:
Jasco Chemical Corporation
Mountain View, California

February 1, 1991

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APPENDIX J

POTENTIAL CONDUITS INVESTIGATION

Potential Conduits Investigation

Jasco Chemical Corporation

Mountain View, California

Prepared for:

BRONSON, BRONSON, AND MCKINNON

May 1988

WAHLER ASSOCIATES

Geotechnical Engineers, Geologists, and Hydrogeologists
1023 Corporation Way
Palo Alto, California 94303
Telephone (415) 968-6250

Project JCO-104H

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POTENTIAL CONDUIT INVESTIGATION

A. INTRODUCTION

Wahler Associates (WA) was retained by Jasco Chemical Corporation to conduct a potential conduit investigation to satisfy the requirements of California Regional Water Quality Control Board (CRWQCB) Clean-Up and Abatement Order (CAO) No. 87-094, issued on August 3, 1987. This report summarizes the investigation which includes identification, location, and evaluation of public and private wells which may be potential vertical conduits for chemical migration from shallow to deep permeable, water bearing zones. This report also summarizes the potential for chemical migration through horizontal conduits within the conduit inventory region (CIR) as required by CAO No. 87-094.

1. Purpose

The potential conduits investigation was conducted to address the possibility that unsealed wells with multiple perforations and/or pervious annular gravel packs which contact areas of contaminated ground water may serve as conduits for chemical migration from shallow to deeper, permeable, water bearing zones. In addition, potential horizontal conduits such as utilities excavations, storm sewers, and the Hetch-Hetchy aqueduct have been created due to residential and industrial development within the Mountain View area. Therefore, this investigation was conducted to assess the possibility of conduits affecting the horizontal and vertical chemical migration within shallow, and from shallow to deeper permeable, water bearing zones in and around Jasco Chemical Corporation.

2. Definition of the Conduit Inventory Region

The conduit inventory region (CIR) has been defined as shown on Figures 1 and 2. The southern boundary of the CIR is Villa Street. The northern boundary is Hackett Avenue. Permanente Creek is the western boundary, and

Granada Drive is the eastern boundary. The CIR boundaries were based on the dimensions of the known A-aquifer chemical plume, in combination with recommended boundaries outlined in the February 18, 1988 letter submitted to Mr. James L. Jaffe by Mr. Steven Morse of the CRWQCB.

B. <u>DATA SOURCE</u>

Available records from many public and private sources were searched to obtain information on the locations of active, inactive or destroyed wells located within and in the vicinity of the CIR. A listing of the references used in this investigation is given at the end of this report.

1. <u>Santa Clara Valley Water District</u>

The SCVWD provided a great deal of useful information regarding the locations of active, inactive and abandoned water wells located at and in the vicinity of the CIR. A representative of WA visited the SCVWD office on Friday, March 11, 1988. Information obtained from the SCVWD on that day, includes a computer printout containing the locations and characteristics of all of the known water wells, excluding monitoring wells, located within the CIR. The listing was compiled as part of the South Bay Multi-Site Cooperative Agreement Well Inventory Investigation prepared for the CRWQCB by the SCVWD. This listing will henceforth be referred to as the well inventory data base (WID). A copy of the report prepared to assist in the use of the WID was also obtained. Although the WID was compiled using existing, available SCVWD data sources, computer printouts and copies of the following data bases and publications were obtained to cross-check the accuracy of the WID: information on registered water producing wells, active and inactive; the SCVWD well locations map for the Mountain View quadrangle; copies of the SCVWD Saltwater Intrusion Investigation reports prepared during October 1980, February 1985, and July 1985. Examination of the Saltwater Intrusion Investigation (SII) reports revealed that the Jasco CIR was not contained within the SII canvass area. In addition to the WID and the additional data sources outlined above, a copy of the monitoring wells search data base for the CIR and surrounding area was obtained. In addition, State DWR Water Well Drillers Reports for all of the monitoring wells located within and in the vicinity of the CIR were obtained from the SCVWD.

Two additional pieces of information obtained from the SCVWD were examined as part of this investigation: the as-built drawings for the improvements to Permanente Creek, and the specifications and contract documents for the improvement of Permanente Creek, 485 feet south of Villa Street to California Street. No wells or other pertinent information were found from the examination of these two sources. A complete listing of the data sources obtained from the SCVWD or examined while at the SCVWD is contained within the references section. The majority of the useful information obtained from the SCVWD was obtained from the WID and monitoring wells search computer printouts.

The entire CIR is contained within the township and range coordinate area 06S2W21. The WID printout for 06S2W16 was also obtained but not used in this investigation. The monitoring wells search output used in this investigation was also compiled using data from 06S2W21.

Historical water level data were also examined. According to the SCVWD, this information is subject to error because the water levels obtained are from old agricultural wells and the depth of perforations is generally unknown.

2. California Department of Transportation/Santa Clara County Planning Department Construction Division

The California Department of Transportation (CALTRANS) was contacted regarding the existence of wells encountered during the construction of Central Expressway. The CALTRANS public affairs office stated that Santa Clara County was responsible for the construction of Central Expressway. A representative of the Santa Clara County Planning Department Construction Division stated that all wells sealed during construction of Central Expressway are recorded by the SCVWD.

In addition, a copy of the Official Map of Santa Clara County prepared in 1902-03 was obtained from the Santa Clara County Planning Department Construction Division. This map was used to cross-check the locations of agricultural wells provided by the local well drillers contacted as part of this investigation.

3. California Department of Water Resources (DWR)

The California DWR regulates well construction and destruction within the State of California. Since 1963, the DWR requires that a water well driller's report be submitted for each well drilled which shows the location of the well and also a log of the soil boring. All DWR well drillers reports for the CIR and surrounding area have been incorporated into the SCVWD WID. The SCVWD and DWR have identical data sets for the CIR and surrounding areas.

4. Santa Clara County Health Department

A copy of the Santa Clara County Health Department (SCCHD) private well sampling program final report was obtained to verify if any of the private wells sampled as part of this program were located at or in the vicinity of the CIR. Attempts were made by the SCCHD to sample well D03, located just east of the CIR but the pump was inoperable and the attempt was abandoned. No other wells within and in the vicinity of the CIR were sampled as part of the SCCHD investigation.

5. City of Mountain View Department of Public Works

The City of Mountain View Department of Public Works provided as-built drawings and other details regarding the installation of sanitary, storm sewers and water mains. As-built drawings for a water relocation system along Central Expressway between Rengstorff Avenue and Bailey Avenue were also examined, but did not contain any well locations.

6. Pacific Bell

Pacific Bell provided maps illustrating the locations and characteristics of their underground telephone lines (main conduits). An engineer was also made available to answer any questions.

7. Pacific, Gas and Electric (PGandE)

A representative of WA visited the Cupertino PGandE office on Thursday, April 14, 1988. Location maps and project files were examined to locate any unregistered wells encountered during the installation of gas and electric mains. An engineer was also made available to answer any questions regarding their buried utilities.

8. San Francisco Water Department (SFWD)

A representative of WA met with Mr. Stan Richards of the SFWD, Milbrae office to discuss the characteristics of the Hetch-Hetchy Aqueduct (Figure 4), and information regarding the presence of unregistered wells located in the Hetch-Hetchy right-of-way within the CIR.

9. Well Drillers

Local well drillers were contacted to obtain access to files containing information about unregistered water-producing wells drilled within the CIR, as well as to obtain well logs of any registered wells within the CIR not in SCVWD files. Bob Garcia, of Garcia Well and Pump, and Frank Clough of C & N Well and Pump, made their private well log files available for inspection; however, no additional information regarding water producing wells within the CIR was obtained.

10. Other Reports and References

A copy of a report, prepared in 1986 for the Clean Water Task Force, entitled "Possible Well Locations: Selected Parts of Santa Clara Valley, California" was obtained from Weiss Associates. The CIR was not contained within any of the study areas canvassed as part of the Clean Water Task Force investigation.

A Copy of "Groundwater in the Santa Clara Valley, California", prepared in 1924 by W.O. Clark was obtained on loan from the U.S. Geological Survey. Two wells, numbers 2142 and 2143, were identified within the CIR. Well 2142 has been tentatively identified as State well number 06S2W21G03 and well 2143 as 06S2W21G04. SCVWD records state that both wells were destroyed in 1966.

C. DEFINITION AND EVALUATION OF POTENTIAL VERTICAL CONDUITS

Potential vertical conduits consist primarily of water-producing or monitoring wells. An exhaustive search was undertaken to locate wells within the CIR, which might serve as conduits between the shallow and deeper permeable zones. Historical and current data were thoroughly examined to determine if potential vertical conduits exist within the CIR that could provide a pathway for vertical migration of chemicals.

1. Water Producing Wells

The locations of active, inactive and destroyed water producing wells found within and in the vicinity of the CIR are shown on Figure 3. A listing of the characteristics of these wells are included as Table 1. The well construction details of wells located within the CIR are given in Table 2. A total of five active, inactive and destroyed water producing wells were found within the CIR (Tables 1 and 2, Figure 3). One of the wells, F01, is Jasco A-aquifer well V-4, located at the northwest boundary of the Jasco site. According to the SCVWD, two of the wells, G03 and G04, were destroyed in 1966; however, the method of destruction is unknown. These wells are located adjacent to the eastern border of the CIR, beyond the area affected by the Jasco plume. A field check by the SCVWD, reports that the locations of these destroyed wells as described in SCVWD records are now covered by a sidewalk. The two additional wells, D#1 and C#2, were identified by aerial photo interpretation as part of the South Bay Multi-Site Cooperative Agreement Investigation. A field check by a WA representative could not locate either well. The reported location of well C#2 is now a residential zone. A backyard tool shed located very close to the documented well location could possibly have been misidentified as a pump house. The reported location of well D#1 is within the Hetch-Hetchy right-of-way. There are four air intake/release valves at this location. These valves are encased in concrete, and could also have been misidentified as a water producing pump. No other water producing wells were found in the CIR as listed in the WID. Four wells located adjacent to the western boundary of the CIR are also shown on Figure 3. Three of the wells, C01, D01, and D09 have been destroyed. Well C01 was destroyed in January, 1972, well D01 during October, 1976, and D09 during April, 1973. The fourth well, C02, is reported to be an inactive well located in the Hetch-Hetchy right-of-way just west of Permanente Creek. According to the SFWD, the well was destroyed in 1974. Attempts were made to obtain the reported destruction permit; however, the permit could not be located by either the SCVWD or the SFWD. It was originally proposed that well C02 would be sampled as part of this investigation. Since the well was reported to be destroyed and could not be located, the well was not sampled.

2. Monitoring Wells

A review of the monitoring wells search computer output for township and range coordinate area 06S2W21 indicates that the only monitoring wells within the CIR are those installed as part of the Jasco investigation. The configuration of the Jasco monitoring network is shown on Figure 5. Table 3 outlines the location characteristics of the monitoring wells. Table 4 discusses the construction details of all monitoring wells within the CIR.

D. DEFINITION AND EVALUATION OF POTENTIAL HORIZONTAL CONDUITS

The direction of groundwater flow in the A-aquifer, at and in the vicinity of the Jasco site, is to the north-northeast. Thus, from current known distributions of chemicals, one can predict, with a degree of confidence, their future potential migration direction. However, if preferential pathways exist in the A-aquifer, chemicals can move in a direction not expected on the basis of the current ground water gradient. These preferential pathways include:

- natural high permeability zones
- sanitary storm sewers and water mains
- the Hetch-Hetchy aqueduct
- gas and electric lines
- telephone lines
- other buried utilities.

This section of the report presents the evaluation of all identified potential horizontal conduits and include all of the documented data.

1. Natural High Permeability Zones

Four high permeability zones have been identified by the characterization work that has been performed by Wahler Associates: The vadose high permeability zone, the A-aquifer, the A_1-aquifer, and the B_2-aquifer. Detailed descriptions of the site stratigraphy and hydrogeology may be found in the following technical reports which have been submitted to the CRWQCB:

- Section C.1 and C.2 of the Phase I Hydrogeologic Investigation submitted to the CRWQCB on June 5, 1987.

- Section C.1, C.2, and C.3 of the Phase II Hydrogeologic Investigation submitted to the CRWQCB on November 5, 1987.

- The stratigraphy and conclusions section of the Aquifer Testing Report submitted to the CRWQCB on December 21, 1987.

- Sections C.1 and C.2 of the Phase IIa Hydrogeologic Investigation submitted to the CRWQCB on March 31, 1988.

2. Sanitary, Storm Sewers and Water Mains

The City of Mountain View maintains separate sanitary, storm and water mains. According to the Engineering Department, information regarding the characteristics of the above-mentioned potential horizontal conduits is very sketchy because, within the CIR, installation occurred before 1960.

Existing sanitary sewers slope north towards San Francisco Bay. According to the City of Mountain View, the maximum diameter of concrete or clay pipes is approximately 30 inches. The maximum excavated depth for installation is said to be 12 to 13 feet. There is no record of the type of backfill used.

Storm drains are approximately 60 to 72 inches in diameter. The maximum excavated depth for installation is approximately 8 feet below the surface. There is no record of the type of backfill used.

Water mains are approximately 16 to 20 inches in diameter, and are located at a maximum depth of 8 feet below the surface. Again, there is no record of the type of backfill used.

Within the portion of the CIR where investigative work has been performed by Wahler Associates, the shallowest depth to groundwater encountered is approximately 24 feet. The difference between this value and the maximum depth of the sanitary and sewer excavations, 12 to 13 feet, makes it extremely unlikely that groundwater is currently or has in the recent past intersected the sewer or water main backfill material.

3. Hetch-Hetchy Aqueduct

The Hetch-Hetchy Aqueduct, oriented roughly east-west, is located approximately 700 feet north of Jasco Chemical Corporation and does not intersect the known A-aquifer chemical plume. The aqueduct, in this area, is an 80-foot wide strip of land containing two pipelines placed side by side. A schematic diagram illustrating the characteristics of the aqueduct is shown on Figure 4. The aqueduct dips beneath Permanente Creek and at that point is encased in concrete.

The remaining length of the aqueduct (within the CIR) is backfilled with a sand and native material mixture. The total excavated depth varies, but within the CIR generally does not exceed 12 feet.

Water movement within the aqueduct is gravity maintained, flowing from the east-northeast to west-southwest, oblique to the direction of groundwater flow.

The total excavated depth of the aqueduct, approximately 12 feet, combined with the aqueduct being located outside the known chemical plume area makes it unlikely that the aqueduct could serve as a potential horizontal conduit given the current hydrogeologic conditions.

4. Utilities

Pacific Gas & Electric (PGandE) provided extensive information regarding the characteristics of underground gas and electric mains throughout the CIR.

a. Gas and Electric - According to the Engineering Department, the maximum excavated depth of the gas mains is 6 feet. The actual depth varies due to residential and industrial development and associated grading. Presently, PGandE uses clean sand to backfill excavated areas; however, before the early 1960's, native materials were used to backfill excavated areas. To prevent corrosion, a cathodic protection system consisting of zinc or magnesium anodes are bonded to the gas pipes.

Electric lines within the CIR occur predominantly above-ground. Underground lines are contained within 3-inch diameter PVC pipes and are located less than 5 feet below the surface.

b. Pacific Bell - According to Ken Leach and John Diaz, engineers with Pacific Bell, it is customary to install telephone lines in conjunction with PGandE using joint trenches. Most trenches are at a maximum depth of 3 feet. However, beneath Central Expressway, two 3-1/2-inch conduits are encased in concrete with 5 feet of cover.

c. Other Potential Conduits - According to various utility company engineers, it is customary to vertically stack conduits (gas, electric, telephone, cable TV) in joint-trenches that have already been installed by PGandE.

d. The shallow depth of the gas, electric, telephone and other utilities excavations make it extremely unlikely that groundwater is currently or has in the recent past intersected the backfill material.

E. CONCLUSIONS

1. 06S2W21F01, installed by WA according to SCVWD regulations, reaches a maximum depth of 40 feet and does not penetrate the B_1-aquifer. Therefore, it is extremely unlikely that well F01 could serve as a vertical conduit for movement of chemicals in the Jasco plume.

2. 06S2W21G03 and G04 are located outside of the known A-aquifer chemical plume. These wells were destroyed in 1966 and may or may not have been sealed according to SCCHD recommendations. Since these two wells are located to the east of the known chemical plume makes it extremely unlikely that wells G03 and G04 could serve as potential conduits for vertical movement of chemicals from the Jasco plume.

3. Field evidence does not support the contention that wells C#2 and D#1 exist within the CIR. A field check of the area surrounding the photo identified revealed objects that could have been mistaken for wells or well pump houses.

4. The Hetch-Hetchy Aqueduct does not intersect the known A-aquifer chemical plume. Maximum depth of excavation is approximately 12 feet and therefore does not penetrate the A-aquifer. Therefore, it is extremely unlikely that the Hetch-Hetchy aqueduct could serve as a potential horizontal conduit for the Jasco plume within the CIR.

5. Underground utilities (gas, telephone, sewers, etc.) are shallow in nature, not exceeding 10 to 12 feet in depth. Therefore, it is extremely unlikely that utilities excavations could serve as potential horizontal conduits for the Jasco plume within the CIR.

F. LIMITATIONS

The data, information, interpretations, and conclusions contained within this report are presented specifically and solely for Bronson, Bronson, and McKinnon. The conclusions and professional opinions presented herein were developed by Wahler Associates, in accordance with the currently accepted geologic and hydrologic principles and practice. This investigation was limited by the fact that the information used in the preparation of this report was written and compiled by parties other than Wahler Associates. In addition, there was no statewide authority enforcing standards and requiring documentation for the construction and sealing of water wells prior to about 1967. Appendix A contains a chronology the State and County regulations regarding well installation and sealing methods employed in Santa Clara County.

WA cannot be held responsible for any conclusions and recommendations made by others, unless we have been given an opportunity to review such conclusions and concur in writing. The conclusions made are subject to change if additional information becomes available.

ANNOTATED REFERENCES

CALIFORNIA DEPARTMENT OF TRANSPORTATION (CALTRANS)

CALTRANS; 1988, Personal communication with Mr. Thatcher, Construction Division.

CITY OF MOUNTAIN VIEW, DEPARTMENT OF PUBLIC WORKS

City of Mountain View, Department of Public Works; 1966, Water System Relocation Plan, File No. 14007-3-4.

______ ; 1988, Personal communication with Tim Lee, Engineering Department.

DRILLERS

C & N Well and Pump; 1988, Personal communication with Frank Clough, owner/driller.

Garcia Well and Pump; 1988, Personal communication with Bob Garcia, former owner/driller.

PACIFIC GAS AND ELECTRIC (PGandE)

PGandE; 1970, San Jose Division Location Maps F-12-2,3 and 3349-F2, F3, F4.

______; 1988, Personal communication with Larry Berg, Engineering Department.

PACIFIC BELL

Pacific Bell; 1982, Main Conduit Location Plan. Record Nos. 2004, 2006, 2008, 2010, 2012, 2014.

____________; 1988, Personal communication with John Diaz, Engineering Department.

____________; 1988, Personal communication with Ken Leach, Engineering Department.

SAN FRANCISCO WATER DEPARTMENT (SFWD)

SFWD; 1950, Deed, A. Kelly and B.J. Kelly and the City and County of San Francisco.

____; 1988, Personal communication with Stan Richards, Milbrae Office.

SANTA CLARA COUNTY (SCC)

SCC; 1902-1903, Official Map of Santa Clara County, revised 1905, 1:25,000.

___; 1988, Personal communication with Don Marcott, Surveyor, Planning Department.

SANTA CLARA VALLEY WATER DISTRICT (SCVWD)

SCVWD, 1965, Santa Clara County Flood Control and Water Conservation District (SCCFC WCD), Zone NW-1, Permanente Creek Plan and Profile, sheets 5,6,7,28, and 29.

_____; 1980, Saltwater Intrusion Investigation in the Santa Clara County Baylands Area, California, by Thomas Iwamura, Engineering Geologist, 2nd printing, with minor corrections, December 1984. Publication was examined, but CIR is not included within study area.

_____; 1984, Field notes for Saltwater Intrusion Prevention Project, Sub-areas E & F, in Well Department Publication was examined, but CIR is not included within the study area.

_____; 1985a, Saltwater Intrusion Prevention Project, Bimonthly Progress Report No. 5, Prepared by John H. Clarke, February, 1985. Publication was examined, but CIR is not included within the study area.

_____; 1985b, Saltwater Intrusion Prevention Project, Bimonthly Progress Report No. 7, Prepared by Richard E. Kimmel, July, 1985. Publication was examined, but CIR is not included within the study area.

_____; 1987a, Well Locations Plotted by DWR - State Well Location Numbers - Mountain View, California, 15-minute Quadrangle.

_____; 1987b, South Bay Multi-Site Cooperative Agreement No. 5-130-120-1, Well Inventory, prepared for the California Regional Water Quality Control Board (CRWQCB).

_____; 1988a, Well Inventory, Section 21, Computer Printout, Well Department.

_____; 1988b, Well Inventory, Section 16, Computer Printout, Well Department; examined for CIR not within Section 16.

_____; 1988c, Requested Statistics for Registered Water Producing Wells, Computer Printout, Water Revenue Section.

_____; 1988d, Monitoring Wells Search, Computer Printout, Water Revenue Service.

_____; 1988e, Well Logs for Monitoring Wells, Water Revenue Section.

_____; 1988f, Master Active and Inactive Well Files, Water Revenue Section.

_____; 1988g, Abandoned and destroyed Well Files, Microfiches, Water Revenue Section.

_____; 1988h, Personal communication with Leslie Bejar, SCVWD Well Department.

SANTA CLARA COUNTY HEALTH DEPARTMENT (SCCHDD)

SCCHD; 1986b, Santa Clara County Private Well Sampling Program, Final Report, January, 1986.

_____; 1988, Personal Communication, Ms. Linda Crawford, Senior E.H. Sanitarian SCCHD.

OTHER REPORTS

Aqua Terra Technologies (ATT); 1987, Potential Well Conduits, Permanente Creek to Rengstorff Avenue, Colony Street to Charleston Road, Mountain View, California. Publication was examined, but CIR is not included within the study area.

Clark, W.O.; 1924, Ground Water in the Santa Clara Valley, California, U.S. Geological Survey Water Supply Paper No. 519.

Weiss Associates; 1986, Possible Well Locations Selected Parts of Santa Clara Valley, California, prepared for the Clean Water Task Force. Publication was examined, but CIR not included within the study area.

TABLE 1
WATER PRODUCING WELLS WITHIN CIR
JASCO CHEMICAL CORPORATION

State Well No.	Location	Local I.D.	Status	Abandonment Certification
06S2W21C#2	70 S. Hackett Ave./ 200 W. Farley St.	None	WA field check was unable to locate	None
06S2W21D#1	150 N. Central Exp./ 270 E. Silverwood Ave.	None	WA field check was unable to locate	None
06S2W21F01	560 North Villa St./ 160 E. Higdon Ave. Ext,	V-4	active	N/A
06S2W21G03	150 North Frontage Rd./ 15 West Granada Dr.	2142	destroyed	Yes
06S2W21G04	194 North Frontage Rd./ 20 West Granada Dr.	2143	destroyed	Yes

TABLE 1 (Continued)

WATER PRODUCING WELLS WITHIN CIR
JASCO CHEMICAL CORPORATION

State Well No.	Date Abandoned	Abandonment Action	Destruction Permit	Date Destroyed	Destroyed Well Seal
06S2W21C#2	N/A	N/A	NO	NR	NR
06S2W21D#1	N/A	N/A	NO	NR	NR
06S2W21F01	N/A	N/A	N/A	N/A	N/A
06S2W21G03	10-28-66	SCVWD Field check: side-walk now covers well area 2-7-67	NO	1966	No Record; possibly 20' - 40' cement cap
06S2W21G04	8-22-66	SCVWD Field check: side-walk now covers well area 2-7-67	NO	1966	No Record; possibly 20' - 40' cement cap

PLANATION:

70 S. Hackett Ave./200 W. Farley St. - well is located 70 feet south of Hackett Avenue, and 200 feet west of Farley Street.

N/A - does not apply
NR - No record

TABLE 2

WELL CONSTRUCTION DETAILS OF REGISTERED WELLS WITHIN CIR
JASCO CHEMICAL CORPORATION

State Well No.	Date Drilled	Well Log	Well Depth (feet)	Bore Diameter (inches)	Casing Diameter (inches)	Driller	Drilling Method	Gravel Pack	Screened Interval	Surface Seal
06S2W21C#2	No record	No	No record	No record	No record	No record	No record	No record	No record	No record
06S2W21D#1	No record	No	No record	No record	No record	No record	No record	No record	No record	No record
06S2W21F01	4-2-87	Yes	35	8	2	HEW Drilling	Hollow-Stem Auger	Yes, Lone Star No. 3 Sand	28'-35'; 0.010"	0'-27' Grout Bentonite
06S2W21G03	No record	No	No record	No record	7	No record	No record	No record	No record	No record
06S2W21G04	No record	No	No record	No record	7	No record	No record	No record	No record	No record

TABLE 3

MONITORING WELLS WITHIN CIR
JASCO CHEMICAL CORPORATION

State Well Number	Location	Local I.D.	APN
06S2W21C01A	78S Central Exway/473E Higdon Ave.	V-6	154 02 040
06S2W21C02A	Central Exway/18W Beatrice St. Ext.	V-7	150 21 500
06S2W21C03A	490S Wright Ave./350E Bonny St. Ext.	I-2	150 21 500
06S2W21C04A	80S Meridian Way/230E Bonny St.	I-3	150 21 500
06S2W21C05A	51N Central Exway/132E Beatrice St.	V-9	150 21 500
06S2W21F01A	436N Villa St./137E Higdon Ave.	V-3	154 02 001
06S2W21F02A	553N Villa St./127E Higdon Ave.	V-2	154 02 001
06S2W21F03A	427N Villa St./170E Higdon Ave.	V-1	154 02 001
06S2W21F04A	554N Villa St./284E Higdon Ave. Ext.	V-5	154 02 001
06S2W21F05A	150S Higdon Ave./550E Villa St.	I-1	154 02 001
Not Assigned	appx. 300S Central Exway/ 300E Higdon Ave.	V-10	154 02 001
Not Assigned	appx. 60N Central Exway/ 105E Beatrice St.	V-8	154 02 500

EXPLANATION:

APN: Assessors parcel number

CONSTRUCTION [illegible]LS OF MONITORING WELLS WITHIN CIR
JASCO CHEMICAL CORPORATION

State Well No.	Local I.D.	Status	Date Drilled	Well Log	Well Depth (feet)	Bore Diameter (inches)	Casing Diameter (inches)	Driller	Drilling Method	Gravel Pack	Screened Interval	Surface Seal
06S2W21C01A	V-6	Active	4-28-87	Yes	42.7	8	2	HEW Drilling Co.	HSA	Lone-Star #3 35.5'-42.7'	37.5'-42.7' 0.010"	0'-35.5' Bentonite & Grout
06S2W21C02A	V-7	Active	4-29-87	Yes	35.5	8	2	HEW Drilling Co.	HSA	Lone Star #3 22'-35.5'	24'-35.5' 0.010"	0'-22' Bentonite & Grout
06S2W21C03A	I-2	Active	8-11/14-87	Yes	54.5	13.5"-48' 7"-BOH	10-Conductor 2-PVC	Weeks Drilling	RM	Lone Star #3 47'-54.5'	49'-54.5' 0.202"	0'-47' Bentonite & Grout
06S2W21C04A	I-3	Active	8-12/21-87	Yes	56.0	13.5'-33.5' 7"-BOH	10-Conductor 2-PVC	Weeks Drilling	RM	Lone Star #3 46.5'56'	49'-56' 0.020"	0'-46.5' Bentonite & Grout
06S2W21C05A	V-9	Active	2-26/29-88	Yes	28.0	8	2	PC Exploration	HSA	Lone Star #3 22'-28'	23'-28' 0.020"	0'-22' Bentonite & Grout
06S2W21F01A	V-3[a]	Active	11-3-86	Yes	35.5	10	5	Unknown	HSA	Lone Star #3	20'-25' 0.020"	0'-17' Bentonite & Grout
06S2W21F02A	V-2	Destroyed; Permit No. 88D0051										
06S2W21F03A	V-1[a]	Active	5-24-84	Yes	48.0	NR	2	NR	NR	Aquarium #4 26'-48'	28'-47' Unknown	0-28' Bentonite & Cement Slurry
06S2W21F04A	V-5	Active	4-27-87	Yes	36.5	8	2	HEW Drilling Co.	HSA	Lone Star #3 32'-36.5'	33.5'-36.5' 0.010"	0-32' Bentonite & Grout
06S2W21F05A	I-1	Active	4-27/ 5-12-88	Yes	57.5	13.5"-41' 7"-BOH	10-Conductor 2-PVC	HEW Drilling Co. Pitcher Drilling	HSA	Lone Star #3 46.3'-57.5'	48.3'-57.5' 0.010"	0'-46.3' Bentonite & Grout
Not Assigned	V-10	Active	3-4/5-88	Yes	32.0	8	2	HEW Drilling Co.	HSA	Lone Star #3 24'-32'	25'-32' 0.020"	0'-24' Bentonite & Grout
Not Assigned	V-8	Active	2-24-88	Yes	37.0	8	2	PC Exploration	HSA	Lone Star #3 31'-37'	32'-37' 0.020"	0'-31' Bentonite & Grout
06S2W21F01	V-4[b]	Active	4-2-84	Yes	35.0	10	2	HEW Drilling	HSA	Lone Star #3 27'-35'	28'35' 0.010"	0'-27' Bentonite & Grout

[a] - Not installed by WA

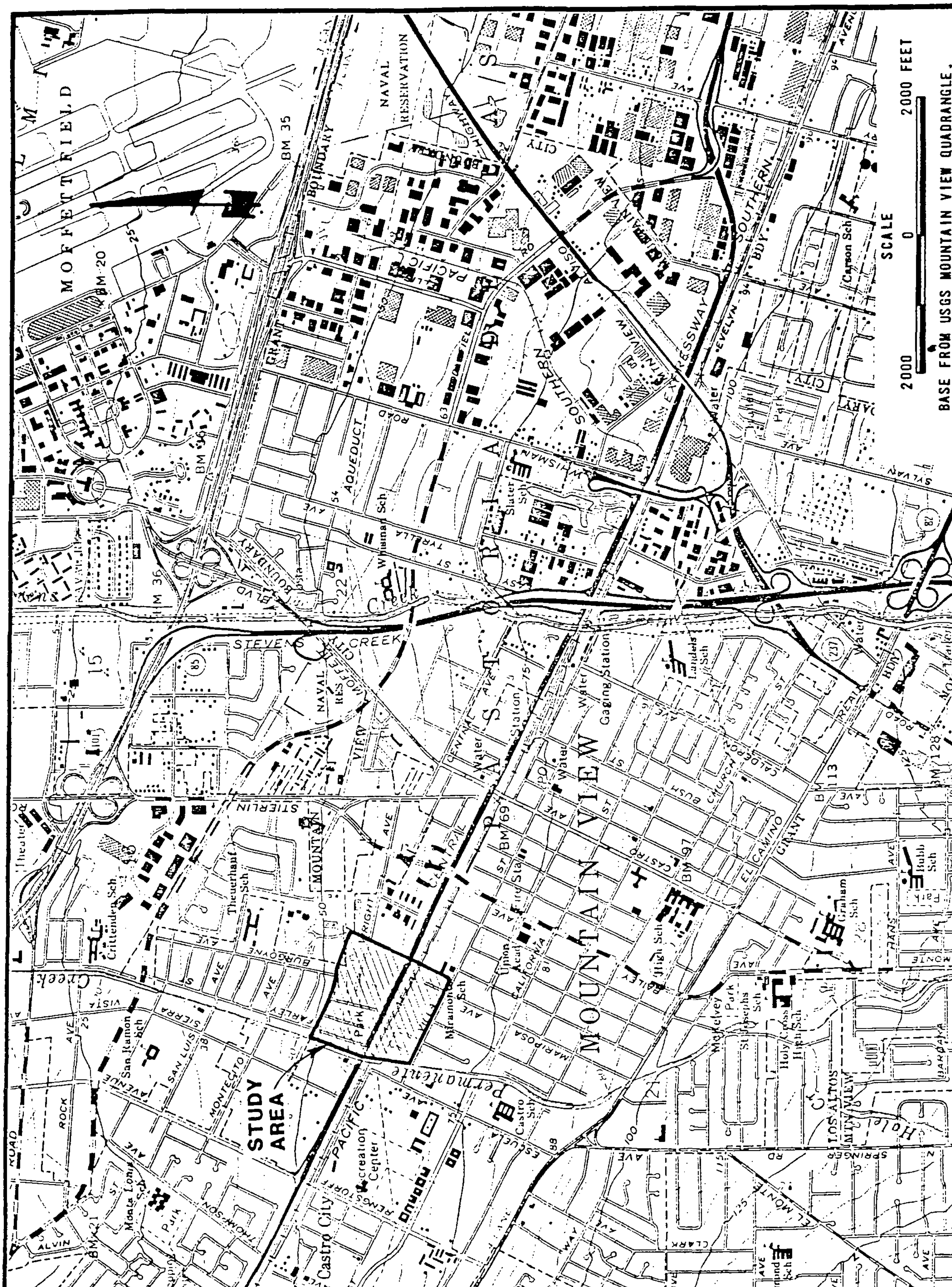
[b] - water producing well also.

NR - No record

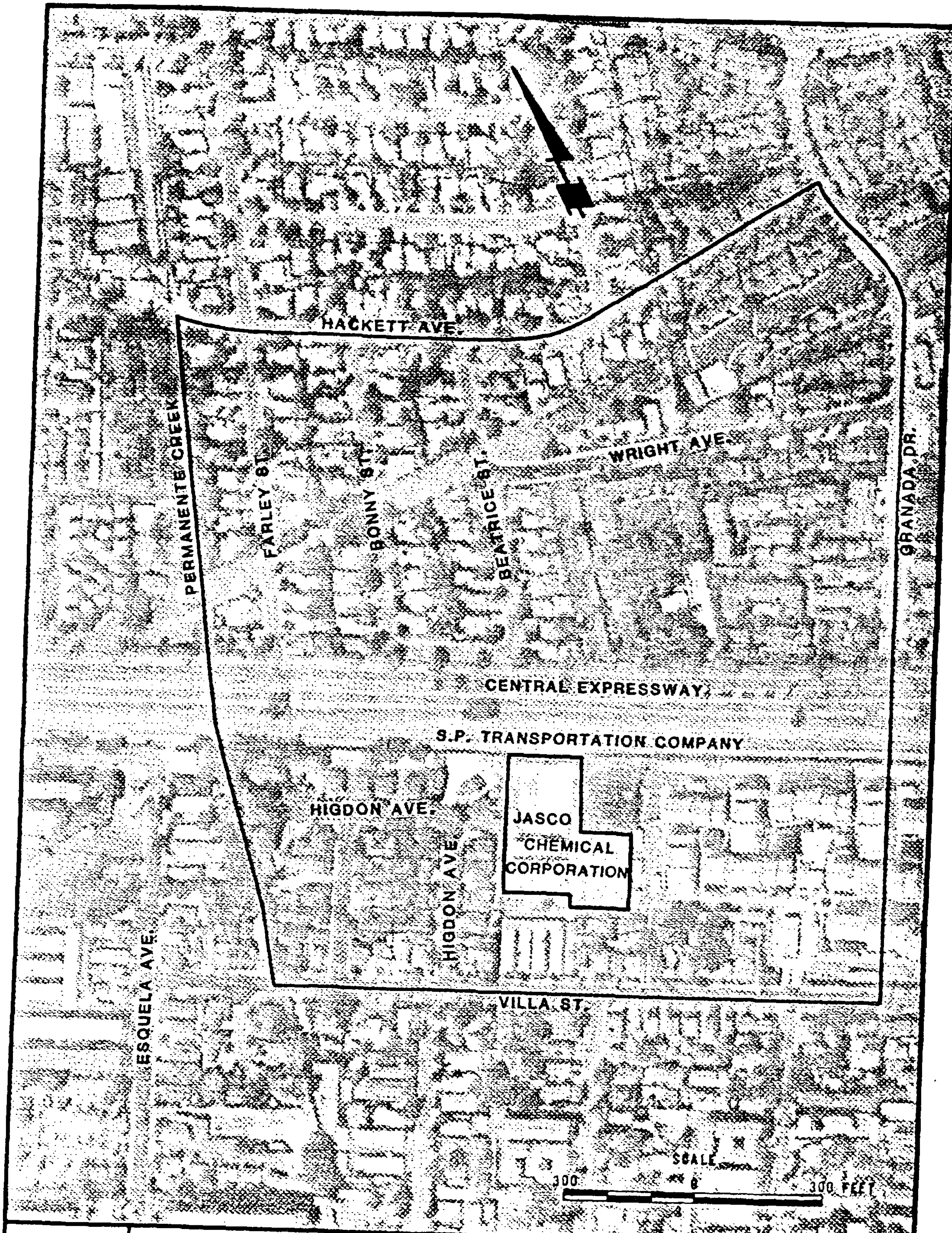
HSA - Hollow-Stem Auger

RM - Rotary Mud

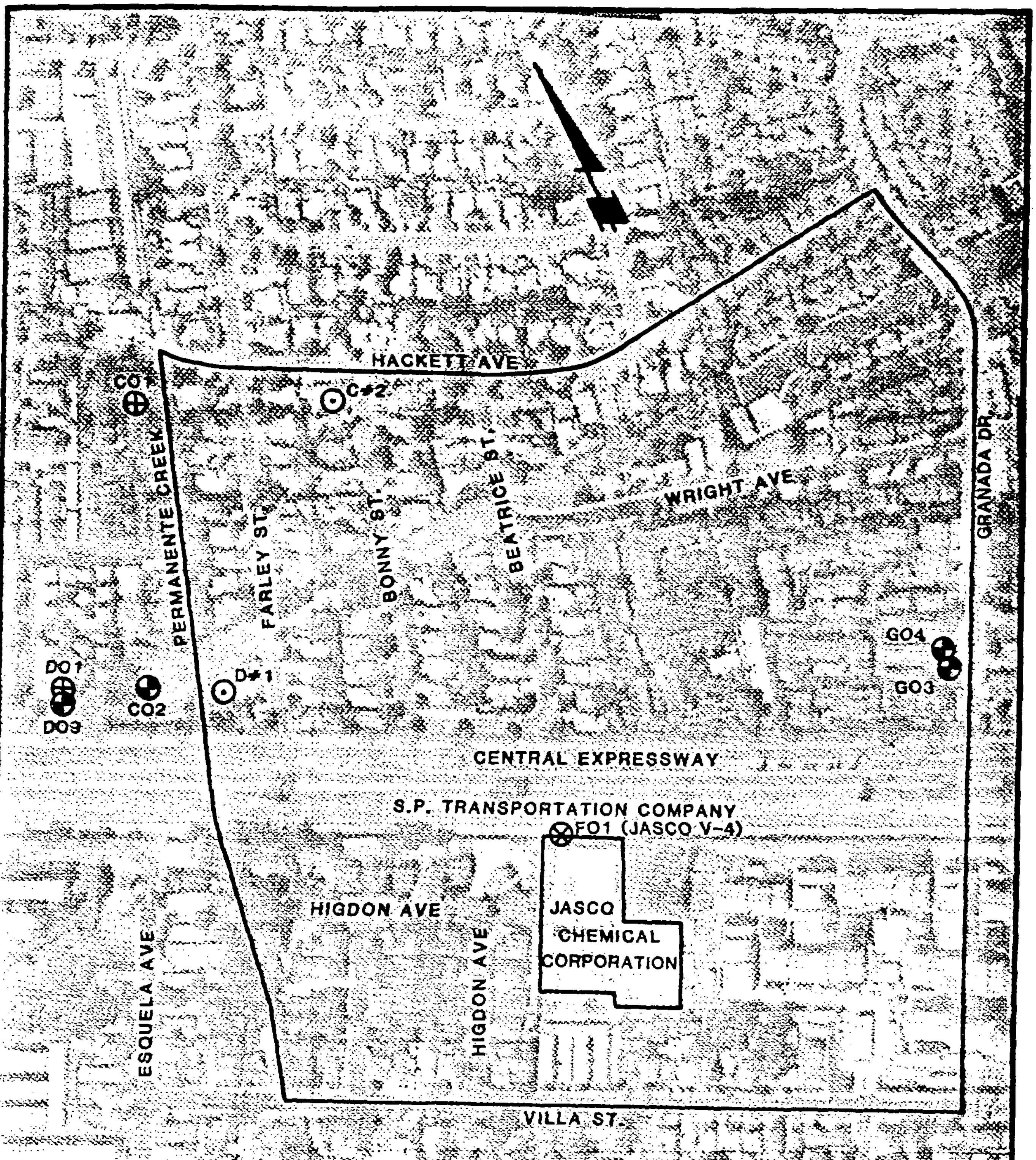
BOH - Bottom of Hole



Wahler Associates	JASCO CHEMICAL CORPORATION POTENTIAL CONDUIT INVESTIGATION	LOCATION OF STUDY AREA		
		PROJECT NO.	DATE	FIGURE NO.
	PALO ALTO • CALIFORNIA	JCO-104H	MAY 1988	1



Wahler Associates	JASCO CHEMICAL CORPORATION POTENTIAL CONDUIT INVESTIGATION	CONDUIT INVENTORY REGION		
		PROJECT NO.	DATE	FIGURE NO.
	PALO ALTO • CALIFORNIA	JCO-104H	MAY 1988	2



EXPLANATION

CONDUIT INVENTORY REGION

ACTIVE INDUSTRIAL WELL

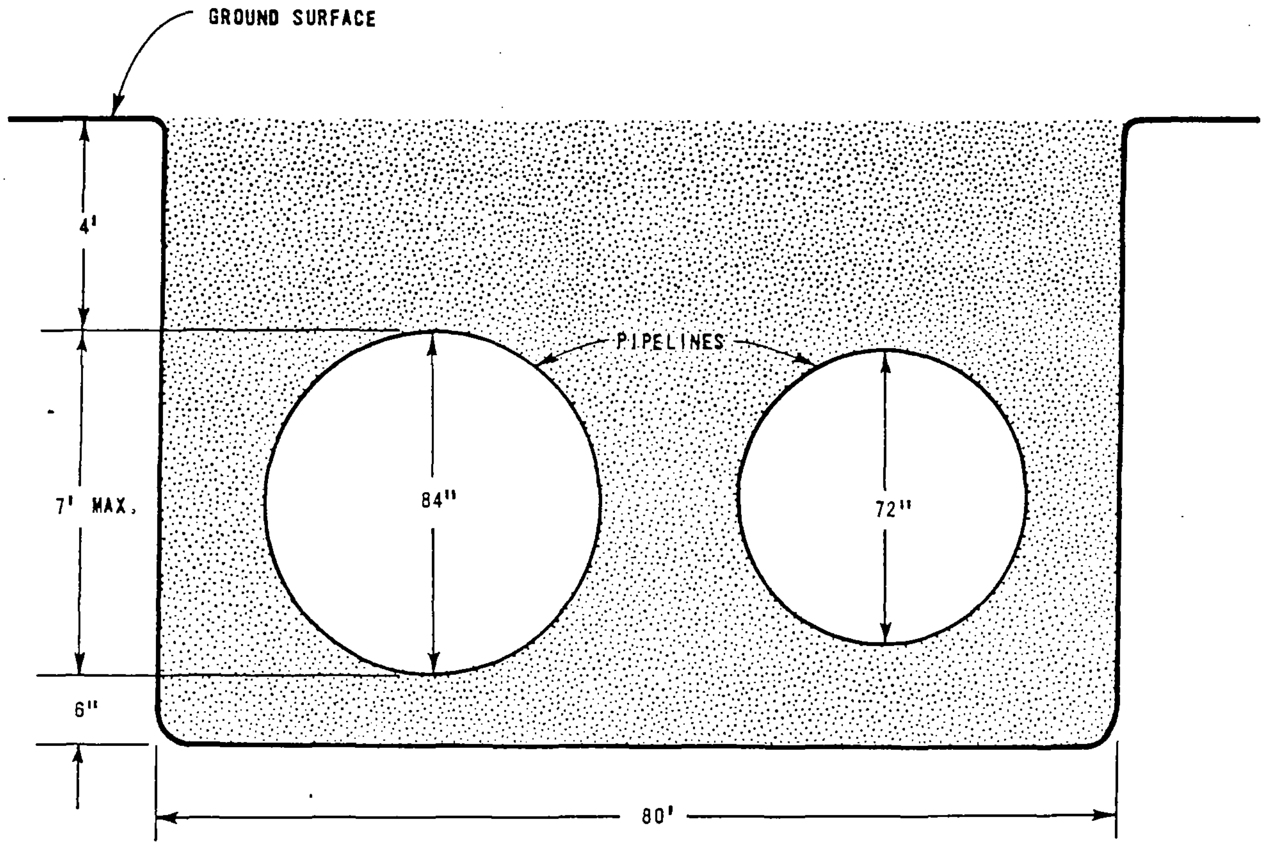
DESTROYED DOMESTIC WELL

DESTROYED WELL - USE UNKNOWN

WELL IDENTIFIED BY AIR-PHOTO INTERPRETATION

300 0 300 FEET

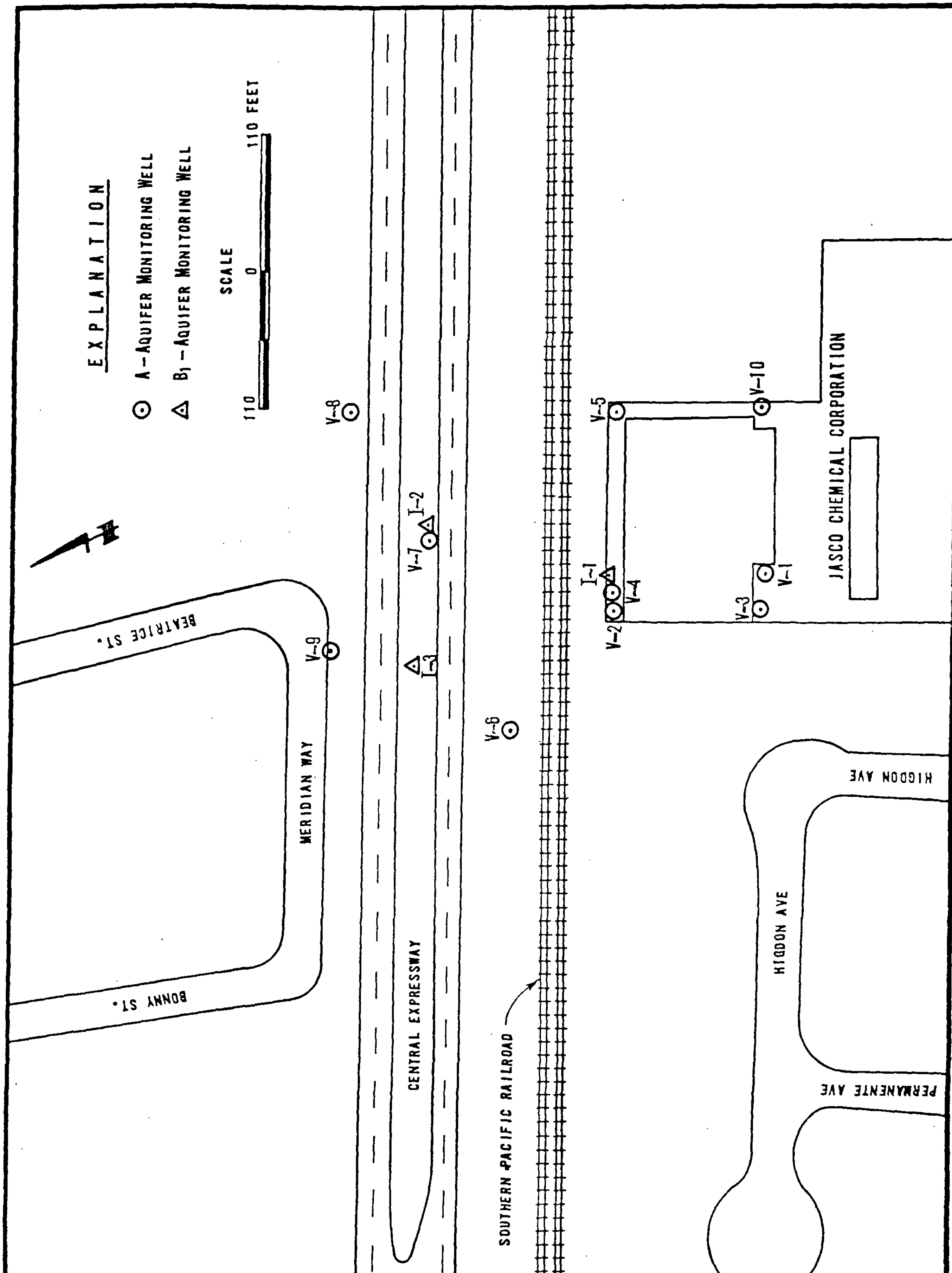
Wahler Associates	JASCO CHEMICAL CORPORATION POTENTIAL CONDUIT INVESTIGATION	PRELIMINARY WELL IDENTIFICATION SUMMARY (NOT INCLUDING MONITORING WELLS)	
PALO ALTO • CALIFORNIA	PROJECT NO. JCO-104H	DATE MAY 1988	FIGURE NO. 3



SAND / NATIVE SOIL BACKFILL

NOT TO SCALE

Wahler Associates	JASCO CHEMICAL CORPORATION POTENTIAL CONDUIT INVESTIGATION	SCHEMATIC DIAGRAM OF HETCH-HETCHY AQUEDUCT		
		PROJECT NO.	DATE	FIGURE NO.
	PALO ALTO • CALIFORNIA	JCO-104H	MAY 1988	4



Wahler Associates	JASCO CHEMICAL CORPORATION POTENTIAL CONDUIT INVESTIGATION	LOCATION OF EXISTING A AND B_1 AQUIFER MONITORING WELLS		
		PROJECT NO.	DATE	FIGURE NO.
	PALO ALTO • CALIFORNIA	JCO-104H	MAY 1988	5

APPENDIX A

WELL CONSTRUCTION

	PERMITS ISSUED BY:	WELLS INSPECTED BY:	RECORDS OF PERMITS &/OR INSPECTIONS	DEPTH OF SEAL REQUIREMENT
PRESENT 1984 1980 1975	SANTA CLARA VALLEY WATER DISTRICT	SANTA CLARA VALLEY WATER DISTRICT	SANTA CLARA VALLEY WATER DISTRICT	* 50' - ZONES 1 & 3 150' - ZONE 2
1970s 1960s 1950s pre-1950s				MINIMUM STATE STANDARDS - 20'

* IN AREAS OF KNOWN CONTAMINATION, EACH WELL REVIEWED ON INDIVIDUAL BASIS TO DETERMINE DEPTH OF SEAL.

REFERENCE: Santa Clara Valley Water District, 5-5-88

WELL DESTRUCTION

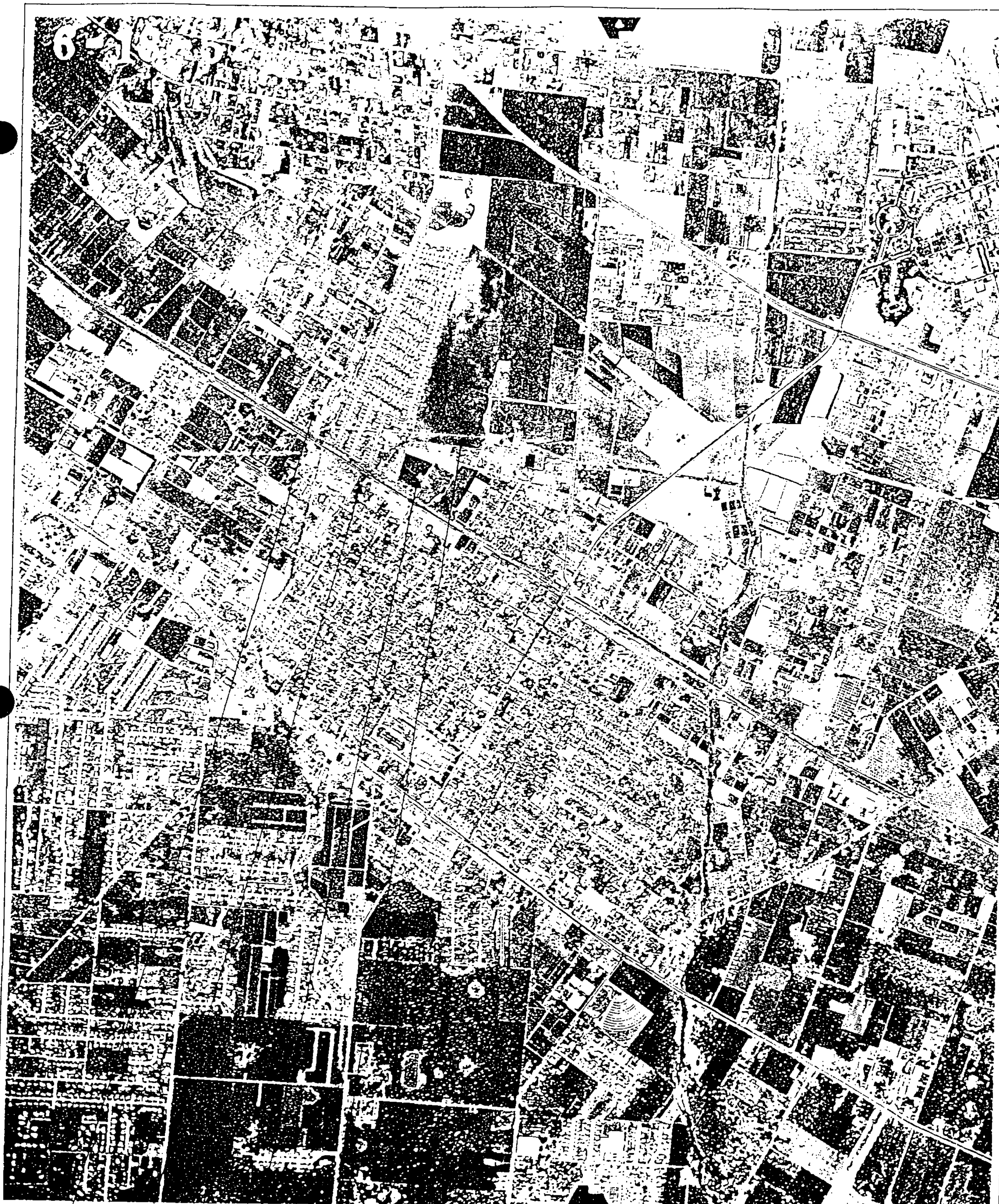
	PERMITS ISSUED BY:	WELLS INSPECTED BY:	RECORDS OF PERMITS &/OR INSPECTIONS	DEPTH OF SEAL REQUIREMENT
PRESENT	SANTA CLARA VALLEY WATER DISTRICT	SCVWD	SANTA CLARA VALLEY WATER DISTRICT	ENTIRE DEPTH OF WELL
1984		SANTA CLARA COUNTY HEALTH DEPARTMENT		50' CAP
1980				
1975	S.C.C. HEALTH DEPT. *			40' CAP
1970s				
1960s				20'
1950s				PEA GRAVEL
pre-1950s				

* LAND DEVELOPMENT PERMIT – CONDITION OF SITE APPROVAL WAS TO HAVE WELL CAPPED. (SEALED')

REFERENCE: Santa Clara Valley District, 5-5-88

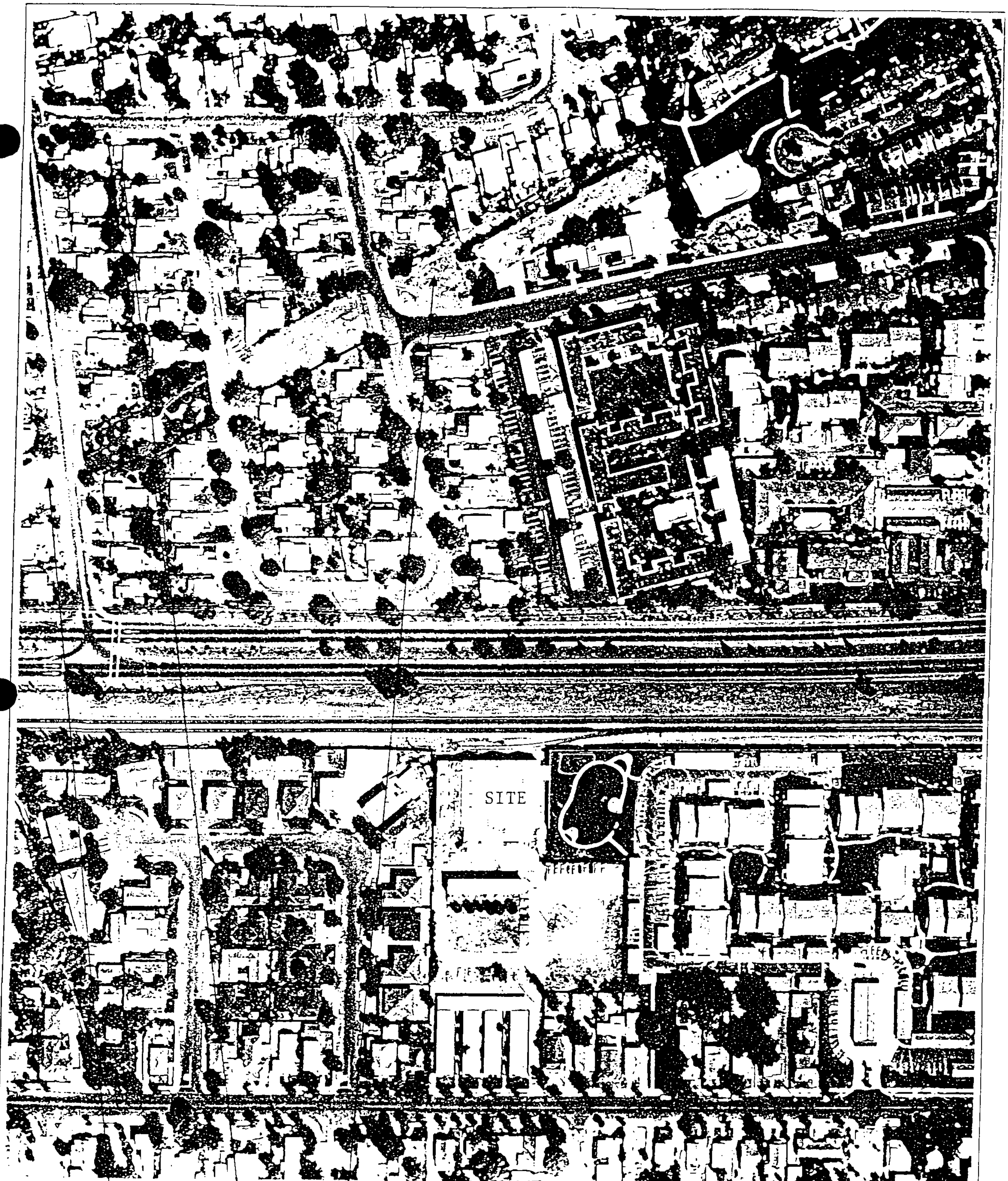
APPENDIX K

AERIAL PHOTOGRAPHS
JUNE, 1952 AND SEPTEMBER, 1988



OHM CORP.

FIGURE K.1
AERIAL PHOTOGRAPH
JUNE 18, 1952
JASCO CHEMICAL CORPORATION



OHM CORP.

FIGURE K.2
AERIAL PHOTOGRAPH
SEPTEMBER 21, 1988
JASCO CHEMICAL CORPORATION

APPENDIX L

BASELINE RISK ASSESSMENT

ENVIRONMENTAL PROTECTION AGENCY
TECHNICAL ENFORCEMENT SUPPORT
AT
HAZARDOUS WASTE SITES

TES IV
CONTRACT NO. 68-01-7351
WORK ASSIGNMENT NO. C09008
ENDANGERMENT ASSESSMENT
FOR
JASCO CHEMICAL CORPORATION
MOUNTAIN VIEW, CA
EPA REGION IX
SITE ACCOUNT NUMBER: 9BF6

JACOBS ENGINEERING GROUP INC.

PROJECT NUMBER 05-B810-00

AUGUST 1989

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EXECUTIVE SUMMARY

This Endangerment Assessment represents the public health evaluation associated with the Jasco Chemical Corporation site, located in the City of Mountain View, California. Exposure pathways were defined to illustrate the potential effects upon human receptors and estimates of the risks associated with these pathways were determined.

The guidance documents used for this assessment were the U.S. EPA Superfund Public Health Evaluation Manual and Exposure Assessment Manual. The Endangerment Assessment was completed using the following procedures:

1) Analyzing high probability and low probability exposure scenarios at or near the site which would be expected to occur in the absence of remedial measures.

2) Estimating the likely range of contaminants concentrations to which individuals who participate in the exposure scenarios may be exposed.

3) Determining best estimate and maximum plausible values for human intake of contaminants from exposure scenarios developed for the site.

4) Characterizing the health effects and health risks to which individuals who are involved in the exposure scenarios may be subjected.

The criteria used to differentiate between risk levels of concern and those that are less significant were the following:

1) A non-carcinogenic risk was considered significant when a chemical intake equaled or exceeded its acceptable chronic or subchronic intake value.

2 A "one in a million" risk or one excess cancer risk in a population of 10^6 after a 70-year exposure period was considered significant in determining carcinogenic risks.

(These criteria were used to characterize and differentiate risks estimated in this Endagerment Assessment only, and should not be considered as the only criteria by which to judge and evaluate any future remediation efforts at the Jasco site.)

Under current land-use conditions of the site the only complete exposure pathway was associated with inhalation of volatilized contaminants originating from the soils. A screening analysis was conducted and it was determined that the potential cancer risk associated with inhalation of volatized contaminants was 5.8×10^{-7}. This risk is within the 10^{-4} to 10^{-7} range which is considered by USEPA to be protective of human health after remediation.

Potential carcinogenic and non-carcinogenic risks were calculated for each of the exposure scenarios associated with potential future land-use conditions (residential occupancy). The risk calculations were made for representative contaminant concentrations (best estimate) and highest measured contaminant concentrations (maximum plausible). As a result each scenario is associated with four risk calculations; best estimate - carcinogenic; best estimate - non-carcinogenic; maximum plausible - carcinogenic and maximum plausible - non-carcinogenic. Results of the findings are as follows:

1) Significant carcinogenic risks were calculated for private well water (A-aquifer) consumption and inhalation of vapors originating from contamianted ground water. Potential excess lifetime cancer risk were determined to be 3.6×10^{-3} (best estimate) and 4.0×10^{-3} (maximum plausible) for ground water ingestion, and 2.7×10^{-4} (best estimate) and 5.9×10^{-4} (maximum plausible) for vapor inhalation.

2) Significant non-carcinogenic risks were calculated for ground water ingestion using representative and highest measured contaminant concentrations.

3) Potential carcinogenic and non-carcinogenic risks associated with exposure to on-site contaminated soils via incidental ingestion or fugitive dust inhalation were not significant.

The Endangerment Assessment has demonstrated that contaminants detected at the Jasco site pose no threat to public health under current land-use conditions. However potential future land-use scenario are described which could pose higher health risks. The assessment identifies pathways that might be impacted by remedial activity and can be used to facilitate the selection of remedial action alternatives.

SECTION 1.0
INTRODUCTION

The remedial investigation conducted at the Jasco Chemical Corporation (Jasco) site has characterized the impacts of the site on the quality of ground water, surface water and soils. This Endangerment Assessment is a basis for evaluating whether or not corrective action is necessary at the site and defines goals for corrective action. The evaluation considers the nature of chemical releases from the site, the potential pathways for human and environmental exposure to the releases, and the degree to which the concentration at the point of exposure exceeds existing standards or acceptable criteria.

The purpose of the Endangerment Assessment is to evaluate the impact to public health that may result from releases from the Jasco site. The assessment considers risks based on current exposure pathways and potential risks that may result from future exposure pathways if no action is taken. A human exposure pathway consists of four elements: a source and mechanism of chemical release, an environmental transport medium such as air or ground water, a point of potential human contact with the medium and a human exposure route such as inhalation of air or ingestion of ground water at the contact point. All four elements must be present to complete a pathway. For the Jasco site, both a current exposure pathway and potential future exposure pathways are evaluated assuming a no remediation scenario.

The baseline evaluation for the Jasco site considers four areas of study: ground water quality, surface water quality, soils and air quality. The objective of the assessment is to characterize the following for each study area:

- The potential for a release from the site.
- The toxicity, quantity, transport and fate of the substance in each media (ground water, surface water, soils and air).
- The presence of an exposure pathway.
- The likelihood of an impact on public health.

This Endangerment Assessment is divided into the Site Characterization (Section 2.0), Selection of Indicator Contaminants (Section 3.0), Exposure Assessment (Section 4.0), Human Intake Assessment (Section 5.0) and a characterization of the overall risk for each exposure scenario (Section 6.0). The detailed tables, figures and worksheets used in the Endangerment Assessment are contained in Appendix A through E. Summary tables are presented in the text.

SECTION 2.0

SITE CHARACTERIZATION

Information presented in this Section was obtained from various reports prepared for Jasco by Wahler Associates. Information obtained from other sources is referenced accordingly. Detailed figures and tables documenting this section are presented in Appendix A.

2.1 Site History and Description

Jasco is located at 1710 Villa Street in Mountain View, California (see Figure 2-1). Jasco has been in operation at this address, repackaging bulk chemicals into small containers and blending chemicals to produce proprietary products, since December 1976. The Jasco site encompasses 2.05 acres and is bordered on the northeast by Central Expressway and Southern Pacific Railroad, main line right-of-way and the Villa Mariposa apartment complex on the east. Single and multi-family dwellings along Higdon Avenue and Villa Street border the Jasco site to the west and south. Access to the site is gained from the south by way of Villa Street.

The site has historically been zoned industrial but was rezoned in December 1983 as residential. The property immediately southeast was previously occupied by Pacific Press and Peninsula Tube Bending. Prior to Jasco, the site was occupied by West Coast Doors, Inc.. West Coast Doors, Inc. used the site from May 1954 to June 1975 to manufacture and paint commercial and residential doors. The site was vacant from June 1975 to November 1976.

The actual plant, offices and storage areas are located at the rear of the property and occupy approximately 31,000 square feet of the total 89,300 square feet (2.05 acres). Approximately 66 percent of the site is vacant land. The facility is a combination of tilt-up concrete production area with a built-up roof. The production area is 4,000 ft^2 and completely explosion-proof wired and heavy-duty sprinklered. The finished goods area is 12,000 ft^2 and of butler-type construction with heavy-duty sprinklers and in-rack sprinklers for storage of flammable finished goods. Figure 2-2 presents the configuration of the Jasco site and layout of the facility.

2.2 Process Description

Jasco's production process involves repackaging of bulk chemicals into small containers and blending of chemicals to produce proprietary products. Bulk solvents are received in tankers and stored in eight underground tanks as shown in Figure 2-3. Filling of the underground tanks is done by gravity. Tanks

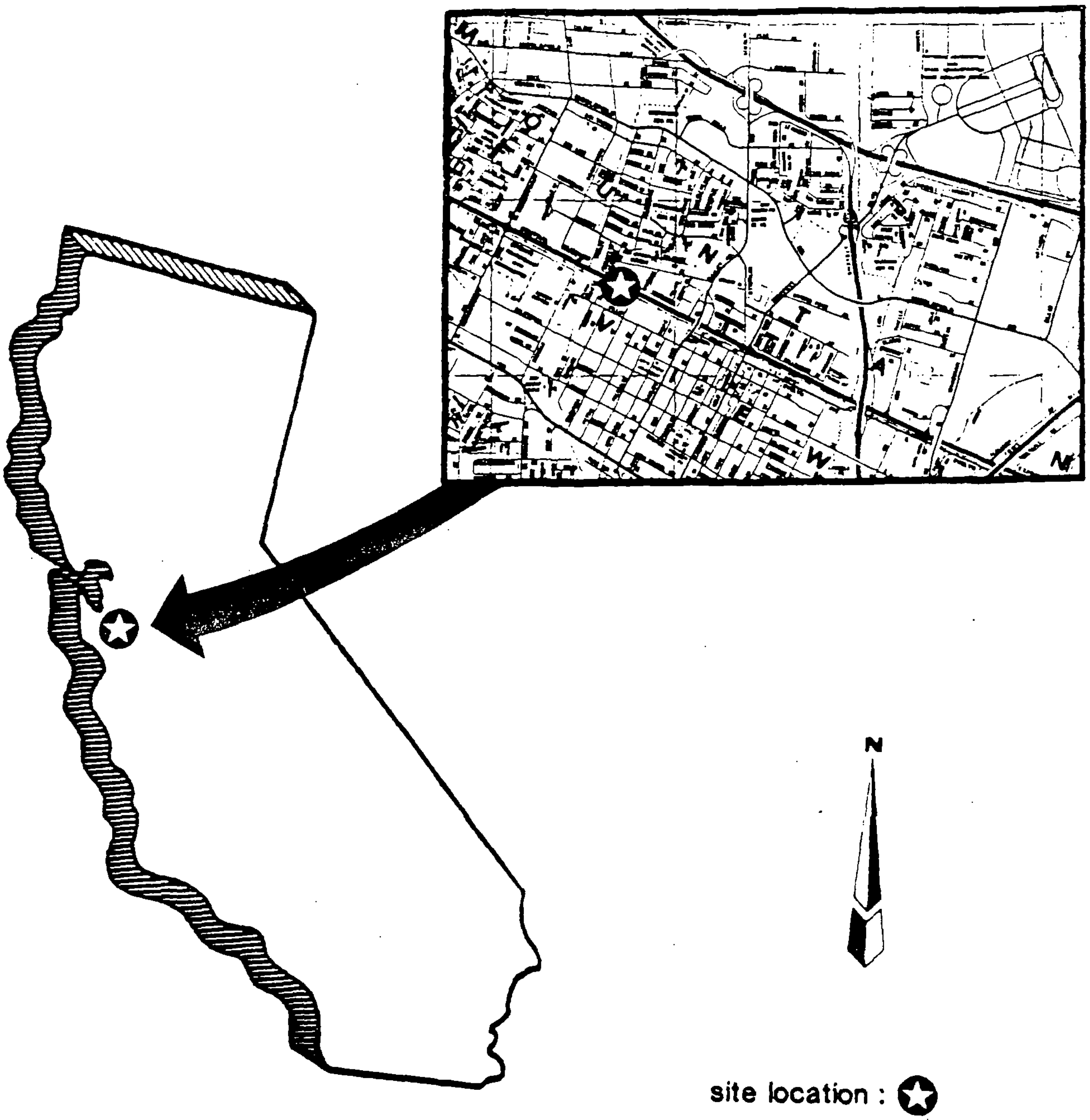
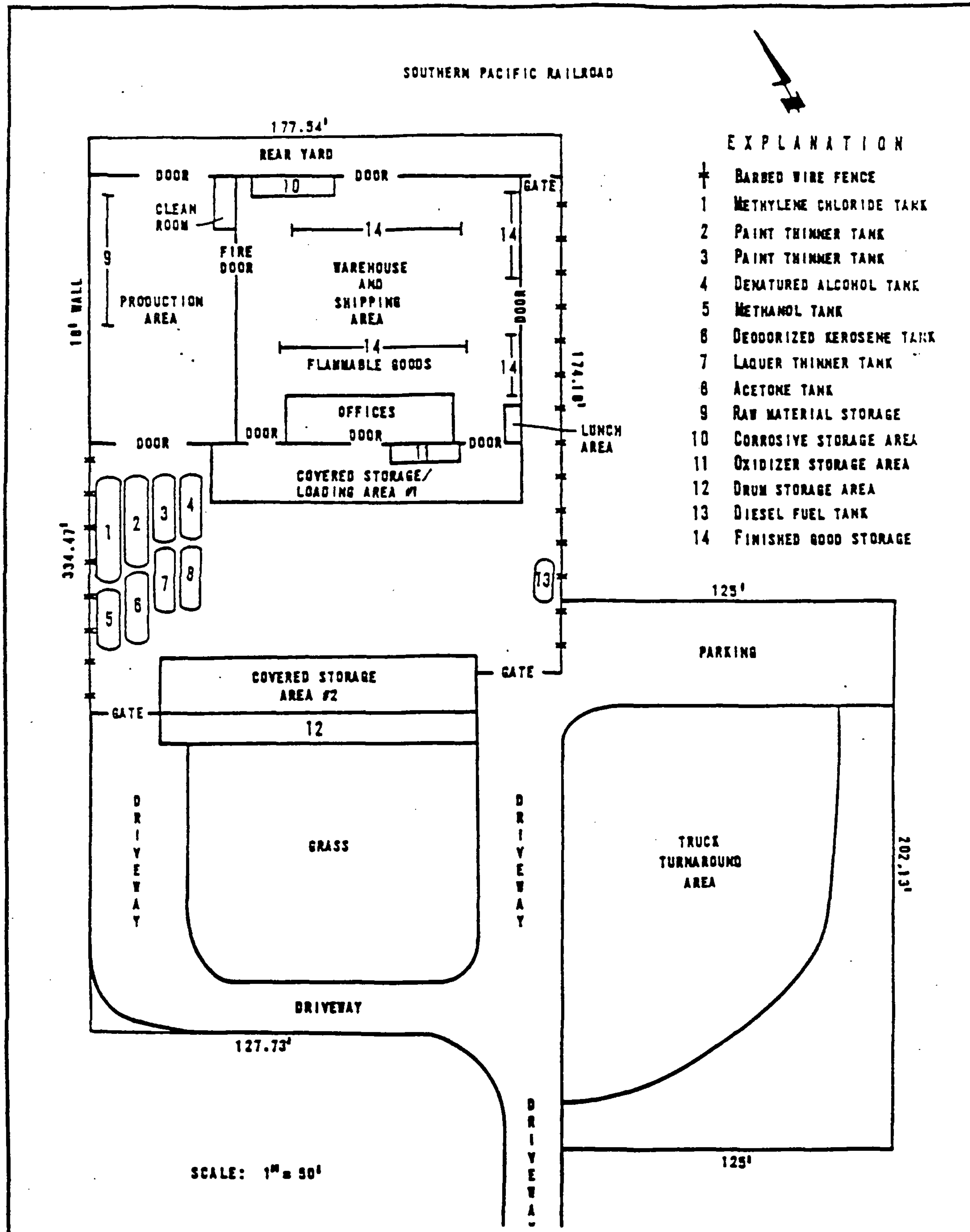


Figure 2-1 : Site Location - Jasco Chemical Corp. Site
Mountain View, CA.



JASCO CHEMICAL CORPORATION MOUNTAIN VIEW, CALIFORNIA	SITE CONFIGURATION	FIGURE
JACOBS ENGINEERING GROUP INC.	Source: Wahler Assoc.	2-2

are checked with a dip stick at least twice a week and is the basis for reordering additional solvents (Wahler Associates, Site Inspection Report, June 1987).

The physical characteristics of the loading and unloading areas are a combination of asphalt and concrete. Putty mixer, filling machine and all above-ground tanks are located in an area that has a reinforced concrete floor with the entire perimeter bermed so as to contain any uncontrolled release (Wahler Associates, Site Inspection Report, June 1987). Figure 2-3 also presents the locations of the bermed area, drains, drainage piping, dry wells, and the on-site sump.

2.2.1 Waste Management Practices

Prior to 1983, South Bay Chemical Co., and IT Transportation were used as the waste hauling companies. Manifest records are available only from 1980 to 1983. In 1983 production piping was altered in order to segregate compatible solvents. This allowed Jasco to accumulate line washings for reuse and eliminated the generation of waste (Wahler Associates, Site Inspection Report, June 1987).

In February 1987, a 55-gallon plastic drum containing methylene chloride was spilled on the concrete portion of the loading area. The spill was reported, and cleaned up by the use of an absorbant within 10 minutes. The spill site was inspected by the City of Mountain View Fire Department, Hazardous Chemical Section, and determined that none of the material had escaped from the site. No other spills of "clean" or waste product are known to have occurred (Wahler Associates, Site Inspection Report, June 1987). There are no known areas at the Jasco site that were or are used to dispose of any material.

2.3 Environmental Setting

The Jasco site is located in the San Francisco Bay area, in a major structural depression situated between the Santa Cruz Mountains on the west and the Hayward-Calavaras fault systems on the east. Locally, the site is bounded on the west by the Santa Cruz Mountains and the Berkeley Hills and Diablo Range on the north and east.

The Jasco site is located on a gently sloping alluvial plain which terminates at San Francisco Bay, approximately 4.5 miles to the north. Permanente Creek, a northward flowing, concrete-lined and channelized stream is located approximately 600 feet to the west-northwest of the site.

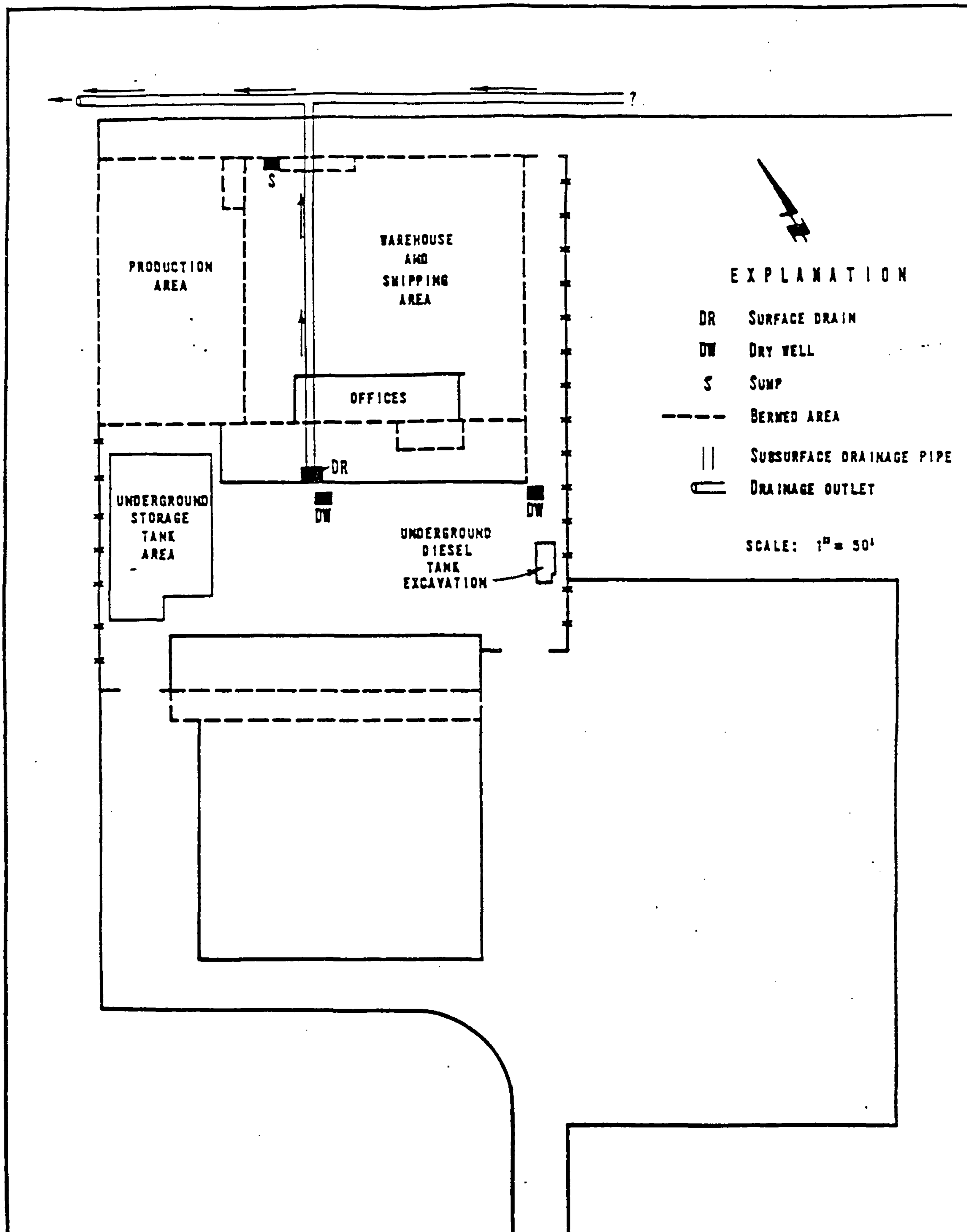
2.3.1 Hydrology

The Jasco site is at an approximate elevation of 60 feet above mean sea level. The surrounding topography slopes gently toward the north-northeast at approximately 100:1 (horizontal to vertical). Surface water on the developed portion of the site drains generally toward the north-northeast, toward the main building. Presently, a portion of the surface runoff flows into a drain which outlets off the northwest corner of the site, adjacent to the Southern Pacific Railroad Line. There, the discharged water ponds and evaporates and/or percolates into the soil. Surface runoff from the non-paved portions of the site is limited, as the site is virtually flat, non-landscaped, and has not developed a significant drainage network.

Permanente Creek, located approximately 600 feet northwest of the site, flows north-northeast toward San Francisco Bay (located 4.5 miles to the north). The creek is concrete-lined, channelized, and is used primarily for drainage and flood control.

2.3.2 Local Geology

The Jasco site is underlain by a thick sequence of unconsolidated sediments of Upper Plio-Pleistocene and Holocene ages. These sediments are considered to extend to a depth of 1,500 feet within the Santa Clara Valley basin, thinning southward to the base of the Santa Cruz Mountains. Benthic bay muds are not considered to form significant deposits in the ancestral Santa Clara Valley, due to the fact that the San Francisco Bay is considered by Helley (1979) not to have extended beyond its current shoreline. However, as sea level rose (transgression) into south San Francisco Bay, estuarine marshlands developed southward into the ancestral Santa Clara Valley. With the transgression of the marshes



JASCO CHEMICAL CORPORATION MOUNTAIN VIEW, CALIFORNIA	SURFACE DRAINAGE CONTROL SYSTEM AND EXTENT OF BERMED AREAS	FIGURE
JE JACOBS ENGINEERING GROUP INC.		2-3

9 Source: Wahler Assoc.

landward, much of the (earlier) coarse-grained alluvial and fluvial deposits were buried by finer grained material. The estuarine deposits became laterally quite extensive during both transgressive and regressive events. Subsequently, in response to increased continental glaciation, the sea level of the ancestral San Francisco Bay dropped, and the previously deposited marsh deposits were regionally eroded, reworked, or buried by renewed alluvial and fluvial processes. Stratigraphically, this produced the general sequence of alternating fine and coarse grained materials.

Descriptions of regional geology can be found in the Endangerment Assessment for the Middlefield-Ellis-Whisman Site in Mountain View, California, prepared by Camp Dresser & McKee, Inc. by ICF-Clement, July 1, 1988. Modified excerpts from this document regarding the regional geology are located in Appendix A as Attachment 1.

2.3.3 Local Hydrogeology

The following information on the Jasco site hydrogeology is taken from a report prepared for Jasco by Wahler Associates, "Evaluation of Interim Remedial Alternatives," June 1988.

Three higher permeability aquifer units have been identified within the upper 70 feet section at and adjacent to the Jasco facility. The three higher permeability units have been designated the A-, B_1-, and B_2-aquifers. Figures A-1 and A-2 present geologic cross-sections prepared from borehole stratigraphic data. Cross-section locations are presented in Figure A-3.

The A-aquifer within the study area is encountered at depths ranging from 22.0 to 35.5 feet below ground surface. The thickness of the A-aquifer ranges from 3.0 to 13.5 feet. The bottom of the A-aquifer extends to depths of 28.0 to 42.7 feet below ground surface.

The B_1-aquifer is encountered at depths ranging from 42.0 to 47.5 feet below ground surface with the bottom of the aquifer at depths ranging from 54.5 to 57.5 feet. The thickness of the B_1-aquifer ranges from 7.5 to 11.2 feet. Analysis of pumping test data indicates that the A- and B_1-aquifers may be hydraulically connected within the study area. The B_1-aquifer is separated from the underlying B_2-aquifer by a low permeability unit designated as the B_1-B_2 aquitard.

Drilling logs indicate that the C-aquifer is approximately 150 feet below ground surface and is separated from the B-aquifer by the B-C aquitard. The B-C aquitard consists of two clay layers, 7.9 and 12.1 feet in thickness. The confining layers are separated by a 20-foot thick cemented gravel layer (refer to drillers logs, Appendix A) (Wahler Associates, Site Inspection Report, June 1987).

Based on the existing site data, a summary of the aquifer systems beneath the Jasco site is as follows:

Zone	Approximate Depths Below Ground Surface
A	22.0 - 35.5 feet
B_1	44.5 - 56.0 feet
B_2	*57.5 feet
C	150 feet

*Encountered in only one boring

Under non-pumping conditions, the movement of ground water within the A-aquifer is towards the northeast (N30xE) with an average gradient of 0.004 ft/ft. The direction of ground water flow within the B_1-aquifer is N15xE, with an average gradient of 0.003. Potentiometric surface maps of the A- and B_1-aquifers were prepared from data collected on October 7, 1987, during non-pumping conditions and are presented as Figure A-4 and A-5, respectively.

Currently, neither the A- nor B_1-aquifers are used for drinking water purposes in the vicinity of the Jasco site. The City of Mountain View operates several municipal wells in the general area which draw water from the C-aquifer.

A description of the regional hydrology is presented in Appendix A as Attachment 2.

2.3.4 Climatology

The San Francisco Bay Area has a characteristic Mediterranean climate with mild wet winters and warm dry summers. The South Bay Area exhibits considerable climatic variability compared to San Francisco with respect to temperature, cloudiness, and sunshine. The Santa Clara Valley lies in the path of winter storms which sweep inland from the North Pacific. Freezing temperatures and snow are extremely rare. Rainfall from the winter storms ranges from moderate to heavy. Climatic data from the Mountain View Corporation Yard (period of record 1975 to present) and the Los Altos Fire Department weather station (period of record 1965 to present) are the most representative for the study area. According to these records, the average annual rainfall is about 14 inches. Over 75% of the total annual rainfall for this area occurs during the winter months of November through March. The average annual wind speed is approximately 6 to 7 mph, with slightly stronger winds occuring during the summer (ICF-Clement, July 1988).

The nearest pan evaporation station is the Alamitos station in southern San Jose. Based on data from this station, and allowing for seasonal variations in both precipitation and evaporation rates, Harding Lawson Associates (1987) has estimated that approximately eight inches of precipitation per year is potentially available for recharge to the local aquifers. However, recharge to the ground water is probably low due to the high degree of urbanization (ICF-Clement, July 1988).

2.4 Remedial Activities

On August 3, 1987, the California Regional Water Quality Control Board (CRWQCB) issued Jasco Clean-up and Abatement Order (CAO) Number 87-094. The CAO contained certain provisions for bringing the facility into compliance and a schedule for completion. The Jasco site has been proposed for inclusion on the Superfund National Priorities List (NPL) by the United States Environmental Protection Agency (EPA).

Preliminary ground water and soils investigations were performed at the Jasco site to determine the nature and extent of potential contamination. The results of the investigations revealed contamination of ground water and soils with chemicals of the same type used and/or stored at the Jasco facility. Subsequent investigations were performed to determine the source and spatial distribution of the contamination problem. Tables A-1 through A-4 in Appendix A presents summaries of the analytical results for ground water, surface water and soils. Reported low and high concentrations of contaminants are presented in Tables 2-1 through Table 2-3.

Jasco and their consultants have been performing ground water remediation activities since February 20, 1987. The concentration of chemicals detected within the vadose zone are confined to a limited area near the northwestern corner of the Jasco facility. The contamination is located in a drainage swale which receives storm water runoff via a subsurface drain pipe. The contamination extends from near-surface to a depth of 21.5 feet. The chemical contamination at this area consists mainly of volatile organic compounds (VOCs) such as paint thinner, methylene chloride, and 1,1,1-TCA. Remedial

TABLE 2-1
SUMMARY OF CONTAMINANTS DETECTED
IN GROUND WATER (A-AQUIFER)

Contaminant	Highest Reported Value Concentration mg/l	Highest Reported Value Location	Lowest Reported Value Concentration mg/l	Lowest Reported Value Location
Acetone	1.80	V-2	0.003	V-8
Benzene	0.02	V-2	0.0019	V-6
Chloroethane	0.180	V-2	0.0031	V-1
1,1,-Dichloroethane	2.2	V-4	0.00069	V-8
1,1,-Dichloroethene	0.17	V-4	0.00065	V-8
1,2,-Dichloroethane	2.58	V-2	0.0010	V-3
Trans 1,2-Dichloroethene	0.013	V-2	0.0014	V-1
Ethylbenzene	0.057	V-2	0.0076	V-2
Methylene Chloride	142.0	V-2	0.0014	V-1
Methyl Ethyl Ketone	0.15	V-2	0.004	V-1
Pentachlorophenol	0.05	V-3	0.0002	V-1
Tetrachloroethylene	0.008	V-2	0.006	V-2
Toluene	0.360	V-2	0.0038	V-4
1,1,1-Trichloroethane	2.04	V-2	0.0018	V-3
Trichloroethene	0.019	V-2	0.0022	V-2
Vinyl Chloride	0.016	V-4	0.00068	V-3
Xylene	0.062	V-2	0.008	V-3

TABLE 2-2
SUMMARY OF CONTAMINANTS DETECTED
IN SURFACE WATER

Contaminant	Highest Reported Value Concentration mg/l	Highest Reported Value Location	Lowest Reported Value Concentration mg/l	Lowest Reported Value Location
Acetone	0.290	Ponded Water/ Drainage Swale	ND(1)	
Benzene	ND		ND	
Chloroethane	ND		ND	
1,1,-Dichloroethane	.056	Ponded Water/ Drainage Swale	0.0039	Discharge Pipe
1,1,-Dichloroethene	ND		ND	
1,2,-Dichloroethane	ND		ND	
Trans 1,2-Dichloroethene	ND		ND	
Ethylbenzene	ND		ND	
Methylene Chloride	1.30	Ponded Water/ Drainage Swale	0.014	Roof Downspout
Methyl Ethyl Ketone	ND		ND	
Pentachlorophenol	0.200	Ponded Water/ Drainage Swale	ND(2)	
Tetrachloroethylene	ND		ND	
Toluene	ND		ND	
1,1,1-Trichloroethane	0.700	Ponded Water/ Drainage Swale	0.0130	Ponded Water/ Drainage Swale
Trichloroethene	ND		ND	
Vinyl Chloride	ND		ND	
Xylene	0.0098	Ponded Water/ Drainage Swale	ND	

(1) Not detected.
(2) Only one value reported.

TABLE 2-3
SUMMARY OF CONTAMINANTS DETECTED
IN SOILS

Contaminant	Highest Reported Value Concentration mg/l	Highest Reported Value Location	Lowest Reported Value Concentration mg/l	Lowest Reported Value Location
Acetone	278.0	Drainage Swale	1.1	Drainage Swale
Benzene	3.0	Drainage Swale	ND(1)	Drainage Swale
Chloroethane	---(2)	---	---	---
1,1,-Dichloroethane	27.0	Drainage Swale	0.34	Drainage Swale
1,1,-Dichloroethene	13.0	Drainage Swale	ND	Drainage Swale
1,2,-Dichloroethane	3.98	Drainage Swale	ND	Drainage Swale
Trans 1,2-Dichloroethene	4.80	Drainage Swale	ND	Drainage Swale
Ethylbenzene	170.0	Drainage Swale	---	---
Methylene Chloride	3400	Drainage Swale	0.99	Drainage Swale
Methyl Ethyl Ketone	ND	Drainage Swale	ND	Drainage Swale
Pentachlorophenol	0.20	0.15ft Well V-2	0.009	20-35ft Well V-2
Tetrachloroethylene	16.0	Drainage Swale	.0067	Drainage Swale
Toluene	1700.0	Drainage Swale	61.0	Drainage Swale
1,1,1-Trichloroethane	22.0	Drainage Swale	0.11	Drainage Swale
Trichloroethene	490.0	Drainage Swale	0.088	Drainage Swale
Vinyl Chloride	ND	Drainage Swale	ND	Drainage Swale
Xylene	91.0	Drainage Swale	1.70	Drainage Swale

(1) Not Detected: Applies to contaminants where only one value was reported.
(2) Not Analyzed.

activities have included excavation of soils from the contaminated area. Figure A-6 in Appendix A presents a summary of chemical analysis results in soils at the drainage swale.

The highest chemical concentration in the A-aquifer has been detected at the northwest corner of the Jasco site, adjacent to the drainage swale where concentrations of chemicals have been detected within the vadose zone soils. Chemicals in the A-aquifer have migrated down-gradient as far as the northern shoulder of the Central Expressway. Isoconcentration maps showing the distribution of chemical concentrations within the A-aquifer are presented as Figures A-7 through A-10. The concentration of chemicals detected within the B_1-aquifer (see Figure A-11) are below DOHS recommended action levels.

Contamination of the A and B_1-aquifers from other sources in the area have been documented. The contaminated sites located down-gradient or cross-gradient from the Jasco site include: the Teledyne and Spectra Physics sites located 0.88 miles north of the site; the CTS Printex site, located 1.36 miles north of Jasco; the "Mountain View 5" sites located 1.50 miles east of Jasco; Hewlett Packard, Logue Avenue site located, 2.20 miles east of the Jasco site, and Moffett Field Naval Air Station, located 2.27 miles northeast of Jasco. The Hillview-Elanor plume is located up-gradient and approximately. 1.72 miles southwest of Jasco (Wahler Associates, Site Inspection Report, June 1987).

Although this Endangerment Assessment assumes a no remediation scenario, the remediation processes that have been previously described cannot be ignored. These processes have significantly altered the collected and evaluated data, and therefore a "true" no remediation condition does not exist.

SECTION 3.0

INDICATOR CONTAMINANT SELECTION

3.1 Introduction

To evaluate the potential impacts that the Jasco site may have on human health, indicator contaminants were selected from chemical compounds identified in ground water, surface water, and soil samples obtained during the remedial investigation. In order to focus the assessment on those contaminants which potentially pose the highest risk, the contaminants were evaluated with respect to their relative toxicity, mobility, prevalence on-site and persistence. From this data, a subset of indicator chemicals was developed. This section explains the approach used to identify the contaminants on-site and the methodology used to adjust and finalize the indicator chemical list. Tables and work sheets showing the indicator containment selection process are presented in Appendix B.

3.2 Indicator Contaminant Selection Methodology

The indicator contaminant selection process involved a review of site characterization data. These include the Preliminary Ground Water Investigation Report (Questa Engineering Corp., 1984), Phase I Hydrogeological Investigation Report (Wahler Associates, 1987) and Surface Water and Soil Sampling Investigation Report (Wahler Associates 1988) as well as chemical-specific physical and toxicological data. The toxicity and physical property data were obtained from the Superfund Public Health Evaluated Manual (SPHEM) along with the appropriate methodology for indicator contaminant selection (USEPA 1986).

The selection of the indicator contaminants focuses on the toxicological properties of the contaminants detected in ground water, surface water and soil. The final list of the indicator contaminants provides a cross section of carcinogenic and non-carcinogenic contaminants that are representative of the most toxic, persistent and mobile contaminants identified through monitoring.

The indicator contaminants were selected from a list of contaminants known to be present at the Jasco site. This list is presented in Table B-1 and was developed from a review of historical documents and available site characterization data. From this list the initial indicator contaminants were selected. Aliphatic hydrocarbon mixtures such as paint thinner and lacquer thinner were not evaluated in the indicator scoring process except when the components of these compounds were analyzed for separately. Gasoline was not represented in the indicator scoring process as it contains aromatic hydrocarbons such as, ethylbenzene and xylene. Individual components were sometimes analyzed for and when available, the data were considered in the scoring process. Contaminants that were infrequently detected during a series of testing programs and/or at low concentrations were not considered representative of site conditions, therefore they were not included on the initial indicator contaminant list.

Concentrations of the contaminants were identified as maximum and representative (mean) concentrations observed during remedial investigation activities. Toxicity data for each contaminant were compiled and reviewed.

Indicator scores for each contaminant were calculated by multiplying the maximum and representative concentrations by the toxicity constant for the specific environmental media. Indicator scores and factors related to environmental mobility and persistence and other chemical and physical characteristics were compiled for each contaminant. The final selection of indicator contaminants was made on the basis of the indicator scores and environmental mobility and persistence.

The specific selection process for indicator chemicals is described in SPHEM (USEPA 1988). Each step in the process is documented in Tables B-1 through B-7. The final indicator contaminants selected include potential carcinogens and non-carcinogens and contaminants exhibiting both qualities. Table 3-1 presents a list of the final indicator contaminants selected.

3.3 Health Effects of Indicator Contaminants

The following presents a summary of the adverse health effects associated with exposure to the individual indicator contaminants. Extensive discussions of the toxicological properties and regulator criteria are presented in Appendix B as Attachment 1.

1,2-Dichloroethane

Human data on subchronic oral toxicity of 1,2-Dichloroethane (1,2-DCA) are not available, and the only available animal data provide inconclusive evidence that effects on the immunological systems of rats and mice are due entirely to 1,2-DCA. However, subchronic inhalation studies in animals have identified rabbits as the most resistant and guinea pigs as the most sensitive to the adverse effects of 1,2-DCA (Spencer et al. 1951). Large doses of 1,2-DCA given to rats have led to high mortality rate in males and females due to toxic, not carcinogenic, effects (USEPA 1984). Chronic occupational exposures to 1,2 DCA have been documented. In most cases inhalation of 1,2-DCA has produced

TABLE 3-1

FINAL INDICATOR CONTAMINANT LIST

Indicator Contaminant	Carcinogen	Non-Carcinogen	Ranking(1) Potential Carcinogens	Non-Carcinogens
1,2-Dichloroethane	X		1	5
1,1-Dichloroethene	X	X	3	2
Trichloroethene	X		4	2
Vinyl Chloride	X		5	6
Benzene	X		6	10
Tetrachloroethylene	X	X	7	16
Methylene chloride	X	X	2	3
1,1-Dichloroethane		X	---	4
Pentachlorophenol		X	---	8

(1) Ranked by maximum indicator score values.

symptoms such as nausea, vomiting, anorexia, irritation of the eyes and respiratory tract (USEPA 1984c).

Animal bioassays provide significant data on the carcinogenic potential of 1,2-DCA. In a 1978 NCI Study it was found that oral doses of 1,2-DCA given to rats produce various tumors in male and female rats (USEPA 1984c). No date are available on the teratogenic effects of oral or inhaled 1,2-DCA in humans or of oral 1,2-DCA in animals. Animal data on inhaled 1,2-DCA have been inconclusive (USEPA 1984c).

1,1-Dichloroethylene

1,1-Dichloroethylene (1,1-DCE) is commonly known as vinylidene chloride. Animal studies, conducted since the early 1960s, have provided almost all of the information from which human effects can be assessed. Subchronic inhalation data have revealed that continuous exposure to concentrations up to 395 mg/m3 result primarily in liver and kidney damage in rats, guinea pigs and monkeys. High exposure to 1,1,-DCE in drinking water appears to produce adverse liver changes in male and female rats (USEPA 1984d).

Animal bioassays with respect to oral treatment of rats and mice with 1,1-DCE have not found evidence of carcinogenicity. However, inhalation studies on rats and mice have demonstrated a possible relationship between mammary tumors in both species and kidney tumors in male mice (Maltoni et al. 1980). Oral studies on the teratogenicity and reproductive effects have been inconclusive, whilst inhalation studies on rats have found fetotoxic effects (Murray et al. 1979).

Trichloroethylene

Inhalation exposure to trichloroethylene (TCE) 2900 ppm has produced lethality in humans and a single oral dose of 7000 mg/kg has also been reported to be lethal to humans (ATSDR 1988b). The primary target organ effected by inhalation exposure is the central nervous system (ATSDR 1988b). Inhalation studies in rats and mice found acute and intermediate duration exposure have produced liver enlargement, increased kidney weight and some liver cell alterations (Kjellstrand et al. 1983). Animal oral studies have suggested adverse effects to the immune system (Tacker et al 1982).

Human studies on the carcinogenicity of TCE are reported in the literature for inhalation exposure, but not oral exposure. In particular, several epidemiological studies completed between 1978 and 1985 found significant excesses of cancer above background with the exception of bladder cancer and lymphoma in one study (ATSDR 1988b), there is inconclusive data available on the developmental toxicity of oral or inhaled TCE to humans. Inhalation studies in rats have found that TCE is fetotoxic, decreases fetal weight and increases litter resorption. Oral exposures to TCE have shown alteration in male rat mating behavior and reduced prenatal survival rate in mice (ATSDR 1988b).

Vinyl Chloride

Inhalation exposure to vinyl chloride has been reported as lethal in high (unquantified) concentrations. Animal studies on rats and mice have indicated that both inhalation and oral exposure to vinyl chloride decreases longevity (ATSDR 1988).

Occupational epidemiology has led to the association of vinyl chloride exposure via inhalation, with various tumors including liver, brain and lung (ATSDR 1988b). Studies in rats and mice indicate that the carcinogenicity of vinyl chloride is manifested as an increased incidence in liver angiosarcomas in rats and lung cancer in mice even at low level inhalation exposures such as 50 ppb (ATSDR 1988c). Human data on inhalation exposures show that there may be an increased likelihood of fetal loss, and alterations in sexual function in both sexes (ATSDR 1988c).

Benzene

Accidental inhalation of benzene by humans has led to limited information on its lethality. It has been suggested that a level of 20,000 ppm for 5-10 minutes (continuous exposure) is an acutely lethal dose (Sandmyer 1981). Studies on rats suggest benzene inhalation has a low acute toxicity. There is a wide range of oral lethal doses reported for humans, the highest being 428 mg/kg (ATSDR 1987). Oral and inhalation studies on rats and mice have led to the conclusion that the systems most affected by benzene are primarily the hematopoietic and immune systems, and in some instances, the nervous system (ATSDR 1987).

Several epidemiological studies have been conducted since 1978 and these have been the basis for the assessment of the risk of leukemia from benzene exposure (ATSDR 1987). Inhalation exposure data revealed a unit risk of 2.6 X 10-2 for leukemia. Benzene has been found to be potentially fetotoxic to mice and rabbits, with effects such as decreased fetal weight evident when exposed to approximately 155 ppm via inhalation (ATSDR 1987). No data are available on oral or dermal exposure routes and no human data are available.

Tetrachloroethylene

Inhalation studies on the lethality of tetrachloroethylene (PCE) in rats and mice have indicated decreased longevity in both species, at high concentrations (1600-1750 ppm) over extended periods of exposure (14 days-13weeks) (ATSDR 1988c). The primary target organs effected by PCE exposure are the central nervous system, liver and kidney.

Inhalation exposure to PCE has been found to result in an elevated mononuclear cell leukemia rate in rats of both sexes and an elevated hepatocellular carcinoma incidence in mice of both sexes (NTP 1986). Animal data on the results of inhalation exposure to PCE showed mice to have an increased number of embryotoxic effects such as split sternabrae and an increased percentage of fetal resorption (ATSDR 1988a).

Methylene Chloride

The only animal study on oral subchronic exposure to animals defined a no-observed-effect-level of 12.5 mg/kg/day in rats (USEPA 1983). Subchronic inhalation exposure to methylene chloride in rats, mice and monkeys appears to be associated with liver and kidney lesions (USEPA 1983). Reported occupational exposure to methyl chloride involved symptoms ranging from mild light headedness to toxic incephalosia following five years of direct contact with the compound daily. A 1983 study (Ott et al.) found no increase in mortality, in men and women, due to cardiopulmonary disease or malignant neoplasm associated with methyl chloride exposure.

Oral exposure bioassays on both rats and mice have found methyl chloride to produce a small but significant increase in the incidence of hepatocellular tumors leading to EPA to conclude the compound has "borderline carcinogenicity" (USEPA 1984f). Animal studies on rats and mice have found significant reductions in fetal body weight and some accelerated bone development in the respective species (USEPA 1984f).

1,1-Dichloroethane

Very few studies on animals have been completed, but inhalation exposures of 1000 ppm to cats revealed renal alterations when exposure continued for five days per week for thirteen weeks. Oral exposure studies in rats have found that sustained high levels of exposure to 1,1-Dichloroethane

(1,1-DCA) produces significant increase in mortality rate and associated renal damage (USEPA 1984b).

Bioassays conducted on rats have found significant increases in mammary adenocarcinoma incidence following chronic oral exposure to 1,1-DCA (USEPA 1984b). However other carcinogenicity tests have failed to find a relationship between 1,1-DCA and tumor incidence (USEPA 1984b). Studies on rats exposed to 1,1-DCA during gestation, via inhalation, show significant alteration in bone ossification of the offspring (Schwetzer et al. 1974).

Pentachloraphenol

Reports describing PCP poisoning in workers or from improper use of PCP-containing products in the home by individuals indicates that brief exposure to high levels of PCP can cause adverse health effects on the liver, kidney, skin, blood, lungs, nervous system, gastrointestinal tract, and death. Long-term exposure to lower levels of PCP can result in damage to liver, blood and nervous system, but the routes of exposure (dermal, oral, inhalation) have not been separated.

There is no convincing evidence from epidemiological studies that indicate that PCP produces cancer in humans. Case reports suggest a possible association between cancer (Hodgkin's disease, soft-tissue sarcoma and acute leukemia) and occupational exposure to technical PCP. (Fingerhut et al., 1984; Greene et al., 1978; Roberts, 1983). However in all these cases the possibility of concurrent exposure to other toxic substances cannot be excluded.

Evidence does exist from animal studies to consider PCP a probable human carcinogen. The best evidence comes from a recent study conducted by the National Toxicology Program (NTP, 1988). The study compared the carcinogenic effects of two PCP preparations, TG-penta and Dowicide EC-7, by oral exposure to mice for two years. EC-7 contained lower levels of the toxic impurities debenzo-p-dioxins and debenzofurans. The incidence of hepatocellular adenomas/carcinomas, adrenal medullary pheochromocytomas (benign and malignant) and hemangiomas/hemangiosarcomas (predominantly in the spleen and liver) was significantly increased in both studies in one or both sexes. In other carcinogenicity studies of various polychlorniated debenzo-p-dioxins only hepatocellular tumors were seen, therefore it can be concluded the PCP itself possesses oncogenic activity.

SECTION 4.0
EXPOSURE ASSESSMENT

4.1 Introduction

The purpose of the Exposure Assessment section of the Jasco Endangerment Assessment is to determine the extent to which the populations surrounding the Jasco site may be exposed to the contaminants released into the environment as a result of past and current Jasco depositions. To accomplish this objective, the following items were evaluated.

- o Study area characterization
- o Potential exposure medias
- o Potential exposure pathways

Once complete pathways were determined, exposure point concentrations of indicator contaminants were determined.

4.2 Study Area Characterization

The study area for this Endangerment Assessment encompasses approximately 138 acres, bounded by Mariposa Avenue on the east, Euscala Avenue on the west, Highway 101 on the north and California Street on the south (see Figure 4-1). The study area is not related to the extent of the Jasco site impact and actually encompasses an area larger than the impacts identified in the remedial investigation. Existing land-uses for the Jasco study area were identified by a field survey. Although the study area primarily supports residential areas, an industrial area and commercial area does exist. Residential areas comprise approximately 90% of the study area. Current City of Mountain View ordinance designate the entire study area as residential zoning.

The Jasco site is the only remaining industrial complex in the study area. Jasco's conditional use permit from the rezoning requires that the company evacuate its present location by 1992. The Jasco site comprises approximately 1.5% of the total study area. One business office complex is located within the study area. The complex is located southeast of Jasco and occupies approximately 8% of the total study area.

The following population data was obtained from information obtained in an Endangerment Assessment report for the Middle-Ellis-Whisman (MEW) site, located approximately 1.5 miles east of the Jasco study area. The report included population data within a three mile radius of the MEW site which includes the Jasco study area. While data from the Endangerment Assessment report

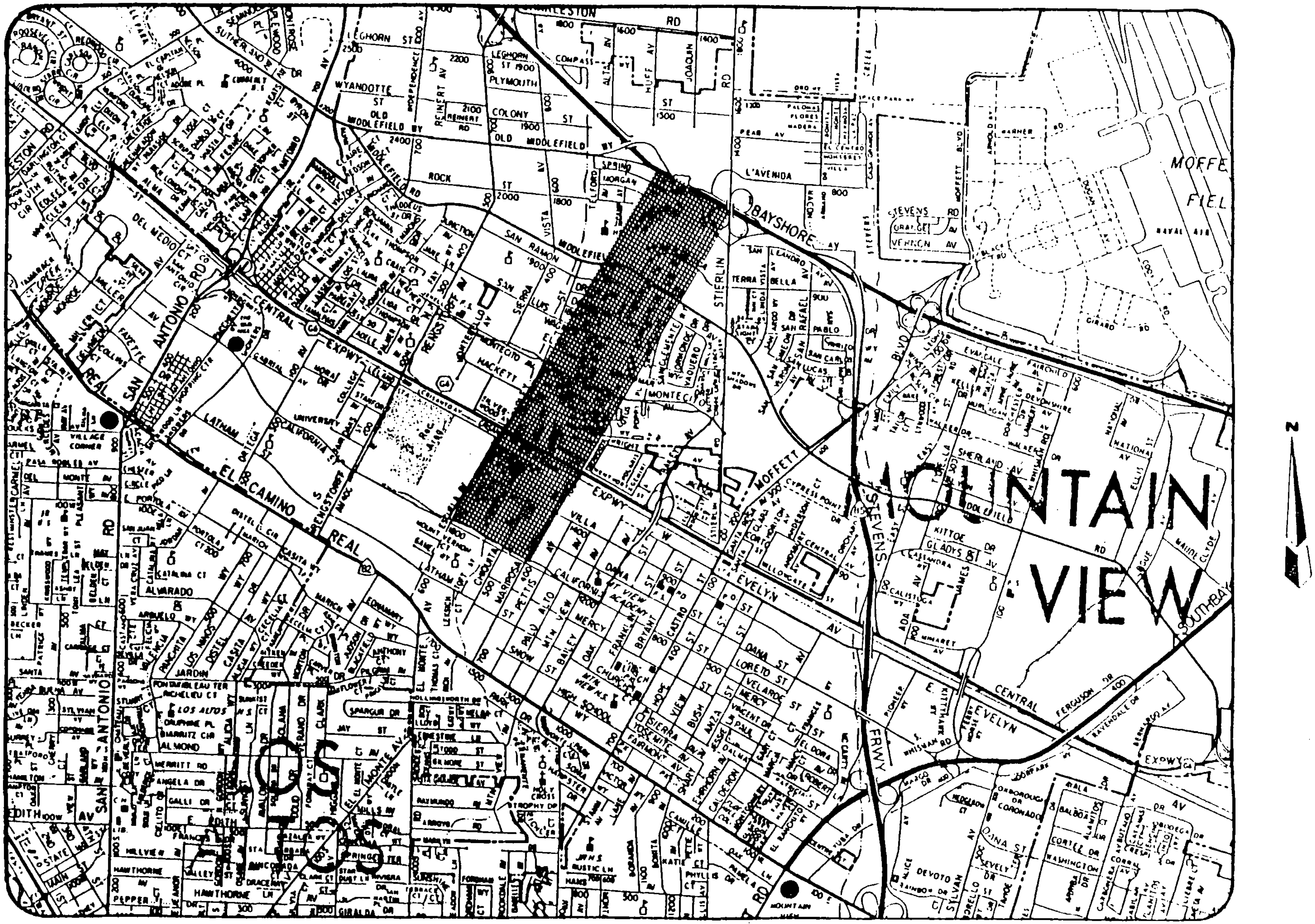


Figure 4-1
Jasco Endangerment Assessment
Study Area

encompasses an area larger than the Jasco study area, the data can be used to evaluate general population trends.

The current population within the Jasco study area is approximately 900, with an annual growth rate of 0.2%. The current average family size is three with no major changes forecast for 1992. The current median and average ages are 36.6 and 38.6, respectively. Adults over 44 years of age comprise 53.4% of the population, with adults in the 30-40 year range comprising 30% of the population. Most children are in the 5-11 year old range with 7% of the total population, followed by the 0-4 year old range with 5% of the total population, and the 12-16 year old range with 4.6% of the total population.

4.3 Potential Exposure Media

At the Jasco site, contaminants have been detected in surface waters, ground water, and soils. Since the indicator contaminants have been found in these media, they are suspected of contributing to the potential exposure of a receptor. The following sections provide insights and evaluation of the particular medias and qualitatively address the potential exposure routes.

Information to date indicates that the primary concern at the Jasco site is the potential for, or existence of, ground water contamination. Because of this, special emphasis is placed on describing and evaluating the ground water pathway.

4.3.1 Ground Water Exposure Media

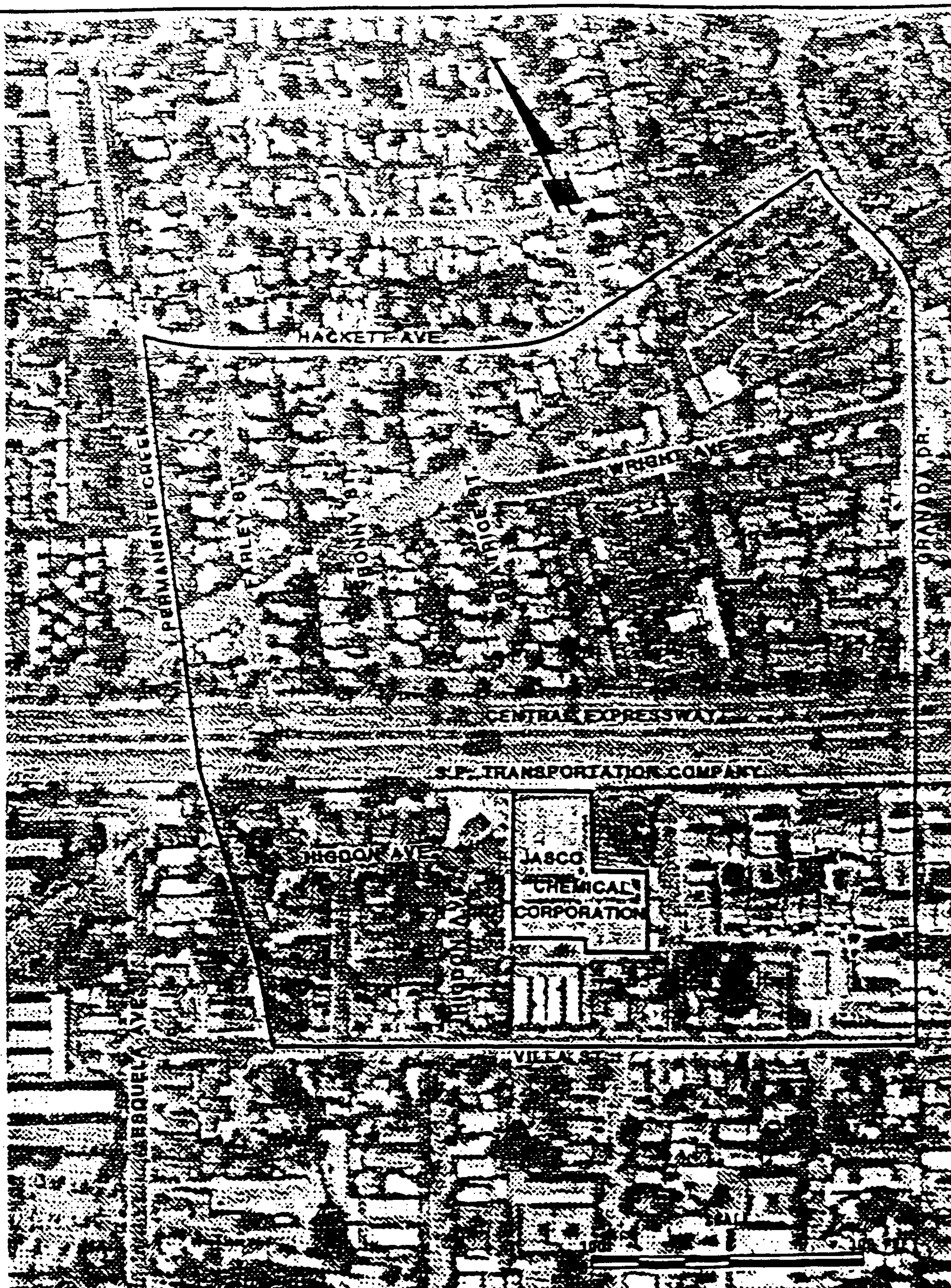
Ground water is regulated by the Santa Clara Valley Water District (SCVWD) with a fee charged for ground water withdrawal. Neither the A or B,-aquifers are currently used for drinking water purposes in the vicinity of Jasco. SCVWD records indicate that there may be old agricultural wells in existence within one mile of the Jasco site. However, a large percentage of the agricultural and private wells in Mountain View have been abandoned under the supervision of the SCVWD. Currently agricultural uses of water are practically non-existent in Mountain View.

It does not appear that contaminants will migrate to any of the City of Mountain View's municipal water supply wells. This is based on the current locations of these wells with respect to the contaminant plume trend, regional hydraulic gradients, and hydrostratigraphic constraints. The municipal water supply wells are completed within the C-aquifer which occurs at a depth of approximately 150 feet below the surface and is separated from the A-aquifer by several aquitard units of which the most noteworthy is the B-C aquitard. The B-C aquitard has never been encountered at the Jasco site due to the lack of any deep exploratory drilling. The B-C aquitard has been investigated thoroughly by Harding Lawson Associates for a study area located approximately two miles east of the Jasco site. Harding Lawson indicates the B-C aquitard to be generally 20-40 feet thick, consisting predominantly of stiff silty clay with occasional sand lenses. Therefore, the C-aquifer is effectively isolated from the overlying aquifers by the B-C aquitard with the exception of where local conduits may provide hydraulic interconnection. (Harding Lawson Associates, 1987).

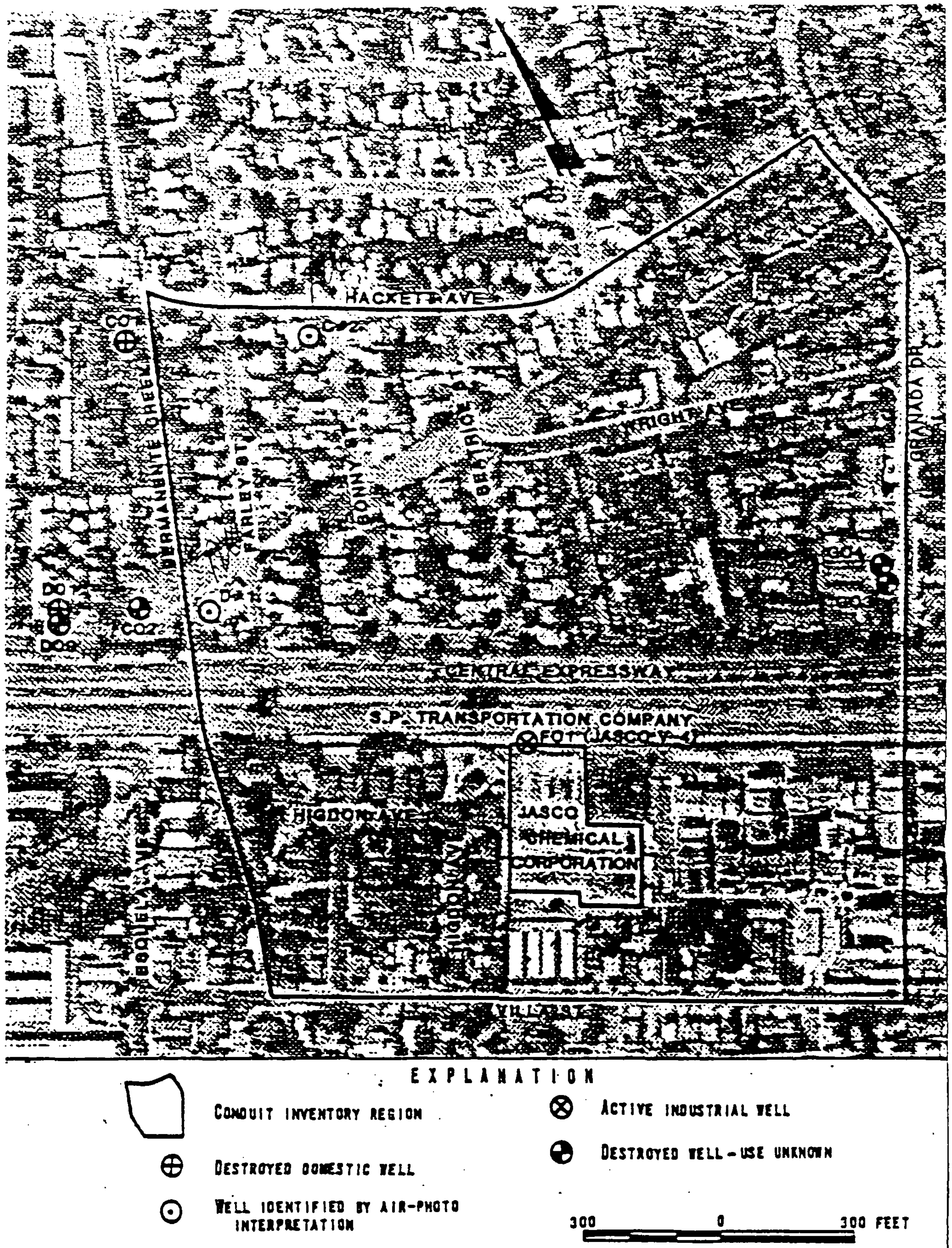
A potential conduits investigation was performed by Wahler Associates for Jasco to satisfy the requirements of Cleanup and Abatement Order (CA0) No. 87-094. The objective of the investigation was to assess the potential for contaminants to migrate from shallow to deeper ground water resources via unsealed or improperly sealed wells with multiple perforations or annular gravel packs which may be in contact with contaminated ground water. The investigation also included an assessment of the potential for horizontal migration of contaminants via activities resulting from residential and industrial development such as utilities excavations, storm sewers, and the Hetch-Hetchy aqueduct. The conduit inventory region is bounded on the south by Villa Street; on the north by Hackett Avenue; on the west by Permanente Creek; and on the east by Granada Drive (see Figure 4-2). The investigation indicated a total of five active, inactive and decommissioned water producing wells within the inventory region (see Figure 4-3). One of the wells (F01), is the Jasco A-aquifer monitoring well V-4. The SCVWD indicated two other wells (G03 and G04) were decommissioned in 1966, with the method of decommissioning unknown. These wells are located on the eastern border of the inventory region and should not be affected by the Jasco plume. The two additional wells seen on Figure 4-3 (D#1 and C#2) were identified by aerial photo interpretation as part of the South Bay Multi-Site Cooperative Agreement Investigation. A field check by Wahler personnel failed to locate these wells. The investigators indicated that a tool shed near the location of well C#2 and a cement encased housing for intake/release valves associated with the Hetch-Hetchy aqueduct near the location of well D#1 may have been mistakenly identified as well pump houses. The investigators indicated there were no other water producing wells located within the inventory region. The only monitoring wells located in the inventory region are the Jasco site monitoring wells.

Contaminant Release and Transport Mechanisms in Ground Water

Ground water flow and contaminant transport follow complex patterns in alluvial/fluvial sediments such as those of the Santa Clara Valley. This is primarily due to the variations in the materials and physiochemical interactions between subsurface materials and the chemical solutes in ground water.



JASCO CHEMICAL CORPORATION MOUNTAIN VIEW, CALIFORNIA	CONDUIT INVENTORY REGION Source: Wahler Assoc.	FIGURE 4-2
JE JACOBS ENGINEERING GROUP INC.		



JASCO CHEMICAL CORPORATION MOUNTAIN VIEW, CALIFORNIA	PRELIMINARY WELL IDENTIFICATION SUMMARY (NOT INCLUDING MONITORING WELLS)	FIGURE 4-3
JE JACOBS ENGINEERING GROUP INC.		

Source: Wahler Assoc.

Hydraulic conductivity is a measure of the relative ability of an aquifer to transmit water (also commonly known as coefficient of permeability). The permeability of sand and gravel is typically several orders of magnitude higher than that of silt and clay. Therefore, lenses and layers of sand and gravel are a preferential pathway for ground water flow and contaminant transport, with silt and clay layers serving as barriers to this flow (confining layers). In most cases, the majority of ground water flow is horizontal, following the subhorizontal orientation of the high-permeability layers. Some vertical flow occurs through the confining layers separating permeable zones with different hydraulic heads.

Detailed studies of the hydraulic characteristics of alluvial sediments demonstrate that estimates of contaminant flow based on measured hydraulic conductivities of specific units are often unreliable. Contaminant migration in complex alluvial environments are best defined by sampling and analysis of monitoring wells.

Contaminant Migration

The dominant contaminant transport mechanisms are advection, dispersion and diffusion. Sorptive phenomena results in the retardation of contaminants. Further reductions in contaminant concentrations result from volatilization and microbial degradation (Ali, no date).

Advection is the process of physical transport of contaminants by the bulk movement of ground water. Dispersion refers to the mechanical spreading and mixing that occurs as ground water follows tortuous paths in randomly distributed sand and clay layers. Diffusion results from the movement of areas of high contaminant concentration to areas of less concentration by molecular forces. Sorption phenomena encompasses both adsorption and absorption processes. Adsorption is the adhesion of chemical molecules to particulate surface, while absorption connotes incorporating chemical molecules within the molecular structure of the subsurface materials.

The migration of volatile contaminants is proportional to the ground water velocity, modified by dispersion, diffusion, sorption, and volatilization effects. Dispersion and diffusion phenomena cause contaminants to spread, so that the margins of contaminant plumes are gradational rather than abrupt.

Sorption generally results in the retardation of contaminants in alluvial sediments. This may be due to clayey soils having a significant sorptive capacity for synthetic volatile organic compounds (VOCs). Concurrently, diffusion and refraction at interfaces between layers of high and low permeability are the main mechanisms of contaminant dissemination in lower permeability layers (Gilham and Cherry, 1982; Hubbert, 1940).

At the interface between the high and low permeablity layers, the processes of diffusion and refraction dominate contaminant migration. At macro- and micro-scales, the principal component of ground water and contaminant flow in sandy layers is largely horizontal. In clayey layers, contaminant migration is largely vertical, occurring mainly by diffusion and enhanced where refraction occurs.

In coarse-grained materials, contaminant dispersion by molecular diffusion is considerably less than dispersion by advection. In the lower-permeability materials, dispersion of contaminants within a complex flow system occurs primarily through molecular diffusion. The driving mechanism for molecular diffusion is the continually changing contaminant concentration contrasts between relatively rapid moving water in the sandy layers, and the lower velocity water in the clayey layers (Gilham and Cherry, 1982).

The extent to which a contaminant advances within the lower-permeability layers depends largely on the thickness of those layers, their permeability, contaminant concentration contrast and time. This implies that higher concentrations of contaminants should be found at the boundaries of the low-permeability layers and concentrations should decrease inward until the layer reaches equilibrium (Gilham and Cherry, 1982).

Refraction of ground water flowlines occurs at the interface of two formations of differing hydraulic conductivity. The angle of refraction is proportional to the contrast in hydraulic conductivity, i.e., the greater the contrast in hydraulic conductivity, the larger the angle of refraction (Freeze and Cherry, 1979).

In summary, flowlines prefer to use high-permeability formations as conduits, and try to traverse low-permeability formations by the shortest route. In aquifer-aquitard systems with permeability contrasts of two orders of magnitude or more, flowlines tend to become almost horizontal in aquifers and almost vertical in aquitards (Freeze and Cherry, 1979). This implies that most contamination would be introduced from the more permeable sediments above, and then flow almost directly downward in the lower-conductivity sediments.

The quantity and direction of refracted flow is directly proportional to the pressure head difference between the two media of contrasting hydraulic conductivity.

4.3.2 Surface Water Exposure Media

On-site surface water is limited to the runoff from the roof of the production/warehouse building and paved areas. The runoff is discharged to a drainage swale, located at the northeast corner of the site. Here the discharge water ponds and either evaporates or infiltrates into the soil. Surface water runoff is limited as the site is virtually flat non-landscaped and does not possess a coherent drainage pattern.

The nearest surface water body to the site is the Permanente Creek. Permanente Creek is approximately 600 feet to the northwest of the Jasco site and flows north-northwest towards the San Francisco Bay. It is concrete-lined and channelized for drainage control purposes. The sole use of Permanente Creek is for drainage and flood control. Surface water at the Jasco site does not drain into it.

4.3.3 Air and Soils Exposure Media

Contaminated soils are confined to the Jasco site and are not easily accessible to the public. The contaminated zone is not in the normal Jasco working area, therefore is undisturbed. Although there is an obvious lack of surficial soil sampling, analysis of soil samples taken indicate that the high concentrations of chemicals occur in the 3-10 feet depth interval. Soil survey data also indicate that contaminated soils are restricted to the Jasco site and that surface soils in the contaminated zone are some ..at cemented and are not readily available for aeolian transport.

4.4 Potential Exposure Pathways

The Endangerment Assessment for the Jasco site has attempted to be as comprehensive as possible, resulting in the consideration of a variety of potential exposure pathways/scenarios. These scenarios are also descriptive of two distinct time frames: 1) the current site condition, and 2) potential future land-uses of the site property and surrounding areas. The following discussions describe these time frames and the exposure implications of these scenarios based on exposure media.

4.4.1 Current Land-Use

Exposure to indicator contaminants are not expected to occur under the current land-use of the Jasco site. This assumption is based primarily on the fact that Jasco will not be operating at the current location past 1992 and the inaccessibility to the contaminated areas. Exposure pathways associated with current land-use of the Jasco site are discussed below. A summary of the potential exposure pathways based on the following discussions for current site conditions are presented in Table 4-1.

<u>Soils</u>

The potential for exposure to contaminated soils by way of dermal absorption and/or incidental ingestion is assumed to be very low to non-existent. Contaminated soils are limited to the Jasco site in a confined area which is not easily accessible to the public and is not located in a normal work area. The potential receptors for the exposure medium are limited to Jasco employees and trespassers. Dermal absorption is insignificant due to the high volatility of the chemicals of concern. Ingestion of contaminated soils is highly unlikely since on-site activities, such as gardening, are not occurring under the current land-use conditions.

TABLE 4-1

POTENTIAL PATHWAYS OF EXPOSURE TO CONTAMINANTS ORIGINATING AT THE JASCO SITE UNDER CURRENT LAND-USE CONDITIONS

Exposure Medium	Potential Routes of Exposure	Potential Receptors	Pathway Completely	Potential for Substance Exposure
Soil	Dermal absorption, incidental ingestion.	Workers, trespassers.	No Contaminants are contained within 3-10 feet depth interval.	None
Air	Inhalation of VOCs and/or fugitive dust.	Workers, trespassers. Local population downwind of site.	No Contaminants are contained within 3-10 feet depth interval.	Very Low
Ground Water	Ingestion, inhalation, dermal absorption.	Local population. of Mt. View	No, public water supplemented with water from wells outside area of influence. No private wells are in use.	None

Air

Jasco employees and residents, located down wind and adjacent to the Jasco site may potentially be exposed to volatile organics and/or contaminated fugitive dusts. Inhalation exposure from the volatilization of organic chemicals in the soils and contaminated fugitive dust is assumed to be very low. As stated in the previous section, the high concentrations of chemicals occur in the 3-10 feet depth interval and are therefore not exposed to the surface. It is also noted that the surface soils in the contaminated zone are somewhat cemented and are not readily available for aeolian transport. Therefore if the soils are not disturbed the potential for volatilization and aeolian transport is very low. Since the contaminated soils are not located in a normal working area, it is assumed that the contaminated zone would remain undisturbed.

Ground Water

Potential contaminated exposure through ingestion inhalation, and/or dermal absorption of contaminants present in the ground water is non-existent. The reasons for this being the regulation of ground water use by the SCVWD and the results of the potential conduit investigation as discussed in the previous sections. Based on the available information it is unlikely that a significant public health risk would occur under the current land-use conditions.

- o The A-B-aquifers are not used as a drinking water source.
- o There are no water producing wells down gradient of the Jasco site, within the boundary of the potential conduit investigation.
- o Regulation of the ground water use by the SCVWD.

4.4.2 Potential Future Land-Use

Potential future land-use of the Jasco site is dictated by the zoning change to residential, which went into effect in December 1983. Therefore the most likely exposure scenario involves future residential use for the Jasco site. A summary of potential exposure pathways is based on the following discussion for potential future land-use and are summarized in Table 4-2.

TABLE 4-2

POTENTIAL PATHWAYS OF EXPOSURE TO CONTAMINANTS ORIGINATING AT THE JASCO SITE UNDER POTENTIAL FUTURE LAND-USE CONDITIONS

Exposure Medium	Potential Routes of Exposure	Potential Receptors	Pathway Completely	Potential for Substance Exposure
Soil	Dermal absorption, incidental ingestion.	Construction workers and on-site residents.	Yes, if surface is disturbed	Moderate, periodic and short-term.
Air	Inhalation of VOCs.	Nearby residents Construction workers on-site residents.	Yes, if surface is disturbed.	Very low, high volatility and dispersion.
	Fugitive dust.	Construction workers on-site residents.	Yes If surface is disturbed.	Moderate, periodic and short-term
Ground Water	Ingestion, inhalation, dermal absorption.	Local population	Yes, if private well installed in area of plume.	High

Soils

Potential exposure to contaminants in soils via dermal absorption and incidental ingestion may occur as a result of on-site construction activities during the redevelopment stage of the Jasco property. This may include excavation type activities such as foundation, sewer, or utility line installation. This type of exposure is expected to be short-term with a low potential for repeated exposure.

Adult residents and children may become exposed to contaminants in soils as a result of gardening activities and playing. This would include both dermal absorption and incidental ingestion of contaminated soils. The contribution by dermal absorption is expected to be low due to the high volatility of the organic chemicals involved.

Air

Residents located downwind and adjacent to the Jasco site and construction workers may potentially be exposed to airborne volatile organic and/or contaminated fugitive dust. Potential exposure may occur as a result of on-site construction activities during the redevelopment of the property. On-site residents including children may become exposed to airborne volatile organic and contaminated fugitive dust as a result of gardening activities and playing. Exposure to airborne volatile organics is anticipated to be infrequent and of short duration with concentrations greatly reduced by ambient air during dispersion. Exposure resulting from contaminated fugitive dust generation is also considered to be periodic and of short duration. The potential for exposure is expected to be moderate.

Ground Water

Future land-use of the Jasco site may include the development and use of private supply wells completed within the contaminated A-aquifer. If these wells are utilized by the residents for drinking and showering, exposure to contaminants by way of ingestion of contaminated ground water and inhalation of volatile organic and dermal absorption may be significant

4.4.3 Conclusions

The following is a summary of the contents of this section.

1. Land-use in this Endangerment Assessment Study Area is predominantly residential, occupying approximately 90% of the land in the study area.

2. The residential population of the area is large and the current trend indicates that population growth is on the incline.

3. A and B,-aquifers, are not used for drinking water purposes in the vicinity of the Jasco site. The City of Mountain View operates several municipal wells in the general area of the site which draw water from the C-aquifer. Agricultural uses are practically non-existent in the City of Mountain View. Sampling data from off-site wells suggest that ground water transport of site contaminants to public wells has not occurred to date. If private supply wells are completed within the A-aquifer and utilized for drinking and showering, exposure may be high.

4. Surface water within the study area has no commercial or residential use and is not considered a potential migration pathway.

5. Contaminated soils are limited to the site. Under current site conditions volatilization of organic chemicals and aeolian transport of contaminated fugitive dust are highly unlikely due to the fact that contaminants are contained within the 3-10 feet depth interval and surface soils are somewhat cemented. If these soils are disturbed during future-use (development and gardening activities) significant exposure to airborne volatile organics is anticipated to be low due to concentrations being greatly reduced by ambient air during dispersion.

4.5 Exposure Point Concentrations

The degree, or magnitude, of exposure to a contaminant is primarily reliant upon the exposure point concentrations. It was determined through past monitoring data that the drainage swale is the on site area which is the most contaminated. For this reason, the drainage swale area was determined to be the primary exposure point from which exposure point concentrations have been determined.

The concentrations in this Endangerment Assessment were determined and expressed in terms of long-term exposure (average concentrations over time) and short-term exposure (high concentrations over time). Short-term exposure levels are the concentrations to which population may be exposed for short periods of time, usually 10 to 90 days. Long-term exposures are defined as the concentrations to which populations may be exposed over a long period of time, usually 70 years. This range of values was chosen to best illustrate the levels of exposures which can occur. Computerized models were used to estimate ground water contaminant distribution over a 70 year period. There were major uncertainties associated with estimating potential contaminant migration, through computerized models, from the Jasco site. Little hydraulic data was available for areas beyond the site and contaminant degradation and transport processes were not defined in accordance to field conditions.

Additional information on modeling efforts can be found in Appendix C. Summaries of exposure point concentrations are presented in Table 4-3 through Table 4-5.

4.5.1 Exposure Point Concentrations Determination Methodology

The following conventions were used to characterize the concentration levels of indicator contaminants at the exposure points. High values were reported in order to illustrate the range of data and to estimate the high exposure concentrations. In cases where the indicator contaminants were reported as not detected in the sampling reports or where concentrations were reported as less than the upper bound value, the exposure value was conservatively assumed to equal the upper bound value. When estimating values determined through numerical modeling, the data points with concentrations less than established water quality standards or criteria were not used in determining the average concentration. All average concentrations were derived by taking the arithmetic mean (average) of the projected data point concentrations (numerical modeling) or sampling data obtained from sampling reports.

Ground Water

Average values were obtained by taking the average of all projected data point concentrations over a 70 year period determined by numerical modeling. High values were developed by selecting the data points which projected the highest concentration levels over time.

Soils

Average values were obtained by taking the average concentration of samples collected over space and time. High values were determined by adding the value of two standard deviations to the average

TABLE 4-3

EXPOSURE POINT CONCENTRATIONS

(GROUND WATER)

Indicator Contaminant	Average Concentration(1) (mg/l)	High Concentration(2) (mg/l)
1,2-DCA	1.7×10^{-1}	1.6×10^{1}
1,1-DCE	5.5×10^{-2}	3.3×10^{0}
TCE	9.6×10^{-1}	1.2×10^{2}
Vinyl Chloride	3.1×10^{-3}	9.8×10^{-2}
Benzene	1.9×10^{-2}	7.3×10^{-1}
Tetrachloroethylene	5.8×10^{-2}	4.3×10^{0}
Methylene Chloride	6.8×10^{0}	8.7×10^{2}
1,1-DCA	2.0×10^{-1}	1.3×10^{1}
PCP	8.2×10^{-3}	3.1×10^{-1}

(1) Arithmetic mean of projected concentration levels over time determined through computerized modeling.

(2) Arithmetic mean of projected highest concentration points over time determined through computerized modeling.

TABLE 4-4

EXPOSURE POINT CONCENTRATIONS

(SOILS)

Indicator Contaminant	Average Concentration(1) (mg/kg)	High Concentration(2) (mg/kg)
1,2-DCA	1.0×10^{-1}	9.9×10^{-1}
1,1-DCE	2.2×10^{-1}	3.6×10^{0}
TCE	6.5×10^{0}	1.2×10^{2}
Vinyl Chloride	5.0×10^{-2}	5.0×10^{-2}
Benzene	9.8×10^{-2}	8.0×10^{-1}
Tetrachloroethylene	1.8×10^{0}	1.6×10^{1}
Methylene Chloride	4.8×10^{1}	8.0×10^{1}
1,1-DCA	1.2×10^{0}	1.5×10^{0}
PCP	1.0×10^{-1}	3.0×10^{-1}

(1) Average concentration equals the arithmetic mean of concentrations of samples collected over space and time.

(2) High concentration equals adding the value of two standard deviations to the arithmetic mean value.

values. These values provide a rough estimate of the upper 95% confidence interval for the average concentration that an individual could be exposed to over a number of exposure events.

Air

Concentrations of contaminants in air, due to volatilization of contaminants detected in ground water, were assumed to be the same as those projected for ground water (Andelman 1985). This assumption is based on 100% volatilization of the contaminant. Therefore, average and high values are the same as those developed for ground water.

4.6 COMPARISON TO OF APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)

The section discusses "Applicable or Relevant and Appropriate Requirements" (ARARs) with respect to the Jasco site Endangerment Assessment. The purpose of this section is to compare actual and projected contaminant levels to ARARs. ARARs for indicator contaminants are used as a comparison to the exposure near and at the site. This comparison will indicate if there is an excessive exposure and potential risk to human health.

In the USEPA's July 1987 Interim Guidance on Compliance with ARARs, EPA defines applicable requirements as "those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitation pomulgated under Federal and State law that specifically addresses a hazardous substance pollutant, contaminant, remedial action location or other circumstance at a CERCLA site (Inside Washington Publishers 1987). EPA also specifies relevant and appropriate requirements as "those cleanup standards, standards of control, or other substantial environmental protection requirements, criteria, or limitations promulgated under Federal and State law that while not 'applicable' to a hazardous substance pollutant, or contaminant, remedial action, location or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site and that their use is well suited to the particular site" (Inside Washington Publishers 1987). Potentially applicable requirements include Clean Air Acts National Ambient Air Quality Standards, and the Safe Water Acts Maximum Contaminant Level Goals (MCLGs).

At the Jasco site, exposure could occur through ground water, air and soil media. The following sections discuss ARARs and other criteria for each of these media and compare these standards or limitations against actual or projected contaminant levels for the indicator contaminant.

TABLE 4-5

EXPOSURE POINT CONCENTRATIONS

(AIR)(1)

Indicator Contaminant	Average Concentration(2) (mg/m3)	High Concentration(3) (mg/m3)
1,2-DCA	1.7×10^{-1}	1.6×10^{1}
1,1-DCE	5.5×10^{-2}	3.3×10^{0}
TCE	9.6×10^{-1}	1.2×10^{2}
Vinyl Chloride	3.1×10^{-3}	9.8×10^{-2}
Benzene	1.9×10^{-2}	7.3×10^{-1}
Tetrachloroethylene	5.8×10^{-2}	4.3×10^{0}
Methylene Chloride	6.8×10^{0}	8.7×10^{2}
1,1-DCA	2.0×10^{-1}	1.3×10^{1}
PCP	8.2×10^{-3}	3.1×10^{-1}

(1) Vaporization of ground water, assumes 100% vaporization.

(2) The average concentration equals arithmetic mean of projected concentration levels in ground water over time determined through computerized modeling.

(3) High concentrations equals arithmetic mean of projected highest concentration points in ground water over time determined through computerized modeling.

4.6.1 ARARs for Ground Water

The ARARs for current use of ground water in the vicinity of the Jasco site are standards and criteria established for drinking. Although there is currently no use of A-aquifer ground water for drinking in the vicinity of the Jasco site, the potential risk that would result if the ground water from this aquifer were ingested was evaluated using the MCLGs permissible in water which is delivered to 25 or more people, or 15 or more service connections. Other criteria that were used to assess the potential risk associated with the consumption of A-aquifer ground water include the proposed MCLs, MCLGs and the California State Action Levels Criteria which are designed to protect human health from chemical constituents in the drinking water. Table 4-6 summarizes the potential ARARs and other criteria established for drinking water.

The USEPA's Drinking water Health Advisories, in addition to MCL's and MCLG, also provide guidance for establishing drinking water quality standards. These advisories exist for 54 chemicals or chemical groups, seven of which are on the Jasco site indicator contaminant list (see Table 4-7). The exposure levels are established to migrate adverse health effects to the public. A safety factor has also been incorporated to protect sensitive population.

The definition for headings used for Table 4-7 follow:

- o One-day: Concentration calculation is based on 10-kg Child (one-year-old infant) consuming one liter of water per day.
- o Ten-day: Concentration calculation is based on a 10-kg child (one-year-old infant) consuming one liter of water per day.
- o Long Term: Concentrations are calculated for both 10-kg child concerning one liter of water per day and 70-kg adult consuming two liters of water per day.
- o Lifetime concentrations are calculated for a 70-kg adult consuming two liters of water per day.
- o Reference Concentrations for Potential Carcinogen. These concentrations indicate a risk of 10^{-6}.

4.6.2 ARARs for Air

The National Ambient Air Quality Standards (NAAQ) are the only regulations applicable to air contaminants at the Jasco site. The State of California provides no State specific ambient air quality criteria. It should be noted, however, that occupational exposure limits provided by the Occupational

TABLE 4-6
POTENTIAL ARARS AND OTHER CRITERIA
FOR CONTAMINANTS IN WATER

Indicator Contaminant	MCL(1) mg/l	MCLG(2) mg/l	CSAL(3) mg/l	Proposed MCL(1) mg/l	Proposed MCLG(2) mg/l
1,2 DCA	(4)	0	.001	.005	---
1,1 DCE	---	.007	.006	.007	---
TCE	---	0	.005	.005	---
Vinyl Chloride	---	0	.002	.001	---
Benzene	---	0	.0007	.005	---
Tetrachloroethylene	---	---	.004	---	0
Methylene Chloride	---	---	.040	---	---
1,1 DCA	---	---	.020	---	---
PCP	---	---	.0022	---	0.22

1. Maximum Contaminant Limits by the Federal Safe Drinking Water Act (USEPA 1986).
2. Maximum Contaminant Level Goal proposed by the USEPA (1986).
3. State Act Level, by the State of California, September 1987.
4. Not available.

TABLE 4-7
EPA DRINKING WATER HEALTH ADVISORS

Indicator Contaminant	One-Day ug/l Infant(3)	Ten-Day ug/l Infant(3)	Long-Term ug/l Infant(3)	Long-Term ug/l Adult	Life-Time ug/l Adult	Reference Concentration for Potential Carcinogens(2) ug/l Adult
1,2 DCA	740	740	740	2600	N/A	0.95
1,1 DCE	1000	1000	1000	3500	---	0.24
TCE	---	---	---	---	---	2.8
Vinyl Chloride	2600	2600	13	46	N/A	0.015
Benzene	233	233	N/A	N/A	N/A	0.35
Tetrachloroethylene	---	34000	1940	6800	---	0.70
Methylene Chloride	13300	1500	---	---	---	5.0
1,1 DCA	---	---	---	---	---	---
PCP	1000	300	300	1050	220	---

1. Source: USEPA, 1985.
2. Values indicate a risk of 10^{-6}
3. 12 months.

Note: See text explanation for heading.

TABLE 4-8

AIR STANDARDS (NON-ARARS)

Indicator Contaminant	PEL(1) mg/m^3	TLV-TWA(2) mg/m^3
1,2 DCA	---	40
1,1 DCE	---	20
TCE	270	270
Vinyl Chloride	---	10
Benzene	10	30
Tetrachlorethylene	170	335
Methylene Chloride	---	175
1,1 DCA	400	810
PCP	0.5	0.5

1. From: Occupational Safety and Health Adminstration, 1989.
2. From: American Conference of Governmental Industrial Hygienist, 1989.

Safety and Health Administration (OSHA) and the American Conferences of Governmental Industrial Hygienists (ACGIH) do exist. These exposure limits are calculated as Permissible Exposure Limits (PEL), as provided by OSHA or as Threshold Limit Value-Time Weighted Average (TLV-TWA) as provided by the ACGIH. Both values are exposure limits assuming an 8-hour work day with a 40-hour work week (see Table 4-8). These values are presented as possible reference levels only and do not imply ARAR status.

4.6.3 ARARs for Soils

There are no Federal standards for contaminant levels in soils. The State of California, Department of Health Services has established Hazardous Waste Threshold Limit concentrations for some organic constituents including TCE and vinyl chloride. The toxicity criteria for these compounds are based on acute fish toxicity. The limits are called Soluble Threshold Limit Concentrations (STLCs) and Total Threshold Limit Concentrations (TTLCs). STLC and TTLC values for TCE and vinyl chloride are shown in Table 4-9. These values are presented as possible reference levels only and do not imply ARAR status.

4.6.4 Results of Comparison

1,1 DCE exceeded or could be predicted to exceed the MCL standard in ground water (see Table 4-10). No potential ARARs were identified for the remaining seven indicator contaminants in ground water, soils or air. However, concentration levels of the seven indicator contaminants did exceed other criteria established by the State of California and the proposed MCL limits set by the USEPA.

TABLE 4-9

SOIL STANDARDS (NON-ARARS)[1]

Contaminant	Soluble Threshold Limit Concentrations (mg/l)	Total Threshold Limit Concentration (mg/kg)
TCE	204	2040
Vinyl Chloride	NA[2]	10

1. State of California, Department of Health Services, 1987.
2. Not available.

TABLE 4-10

EXPOSURE POINT CONCENTRATIONS VS POTENTIAL ARARS OR OTHER CRITERIA FOR CONTAMINANTS IN GROUND WATER

Indicator Contaminant	Potential ARARs (mg/l)	Other Critical(1) (mg/l)	Contaminant Concentration(2) (mg/l)	Standard Ratio
1,2 DCA	---	.001	0.17	170
1,1 DCE	.007	---	0.055	8
TCE	---	.005	0.96	192
Vinyl Chloride	---	.001	0.0031	3
Benzene	---	.0007	0.019	27
Tetrachloroethylene	---	.004	0.058	15
Methylene Chloride	---	.04	6.8	170
1,1 DCA	---	.02	0.2	10
PCP	---	.0022	0.0082	3.73

(1)Potential ARARs and other criteria listed in Table 4-6.
(2)Average concentrations.

SECTION 5.0
HUMAN INTAKE ASSESSMENT

5.1 Introduction

Since all indicator contaminant concentrations in ground water exceeded ARAR standards or other criteria limits, the risk characterization process was conducted for each exposure scenario. The concentration for the indicator contaminants at exposure points are used to calculate the exposure and intake levels for future land-use scenarios. The assessment of human intake is quantified in this section for those exposure events that were thought to be the most possible. These include the exposures that are likely to occur on a much more regular basis. The risk estimates for these most probable events were developed using a mathematical matrix that made provisions for a distribution of exposure and subsequent intake as a function of, for example, time activity and body weight.

This section describes the procedures used to determine human intake resulting from ingestion and inhalation exposure. Risks resulting from dermal intake are not calculated in this Endangerment Assessment because no methodologies are currently unavailable for inclusion with the intake estimates currently used.

The intake scenarios used in this section are representative of exposures assumed would occur on a repeating and regular basis. These include for example direct consumption of ground water at or in proximity of the Jasco site.

5.2 Intake Calculation Assumptions

Estimating human intake exposure point concentrations required the development of a methodology that represents the variability of exposure. For each separate scenario specific assumptions applicable only to them were developed. However, in many cases standard assumptions common to all exposures and consequently intakes were used. In particular, the standard weights of 70 kilograms (154 pounds) for adults and 17 kilograms (38 pounds) for children were used. These standard assumptions were applied for exposure to both ground water and soils. Although there are currently several reviews taking place by the USEPA and the scientific community on the issue of actual values for body weight, the values stated above were used in view of the traditional consensus presented in USEPA methodology (USEPA 1986).

Similarly although a range of values exist for total daily water consumption by adults and children, the traditional approach under SPHEM and Superfund Exposure Assessment Manual (SEAM) guidance documents is to use two liters (.53 gallons) per day for adults and one liter (.27 gallons) per day for children. Although these values are conservative as direct consumption values, and lower values are more reasonable, a narrow range around these values was assumed to be more suitable for conditions present at the Jasco site.

The definition of short-term (subchronic exposure) and long-term (chronic exposure), as they pertain to discussion in this document are 10 to 90 days and 70 years, respectively. Those assumptions are documented in SPHEM (USEPA 1986). For the purpose of this Endangerment Assessment the 90 day duration was selected as the short-term duration. Given the exposure scenarios selected, this time period was considered likely to provide a more accurate estimate of exposure to the identified indicator contaminants at the characterized exposure points discussed in Section 4.0. It should also be noted that intakes for children were only calculated for the short-term period, and not for the lifetime 70 year period, as the duration of childhood is limited.

The emphasis of the methodology presented below was to take into consideration as much of the potentially explored population as possible and identify those intakes that could potentially result in clinical manifestations of toxicological end points. In order to do so assumptions were chosen to be conservative enough to include the 90th percentile of the population within the Jasco study area, as it would be unreasonable to predict that all of the population would fit the assumptions all of the time. The following sections predict the intake calculation assumptions specific to the exposure media, with scenario specific discussion.

5.2.1 Water Ingestion

The ingestion of water at the hypothetical residences using private wells completed within the contaminated A-aquifer is described in this section. The assumptions used in calculating ground water ingestion, as the sole source of drinking water, would average two liters per day as a consumption rate, for adults, and one liter per day for children (USEPA 1986). In addition, it was assumed that as both a best estimate and a maximum plausible value, 100 percent of the water consumption by children occurs at home. Adults were assumed to consume 80 percent of their water at home as a best estimate, and 100 percent as a maximum plausible value. These assumption were made because adults are likely to consume water both at home and away from home. Children were conservatively assumed to consume 100 percent of their water at home.

Since the source of ground water for this scenario is residential, it was reasonable to assume that every day of a short-term, 90-day period and a long-term 70 year (25,550 days) period, represented a day of ground water ingestion for adults.

5.2.2 Soil Ingestion

This section describes the assumptions that were used to calculate soil ingestion for the future land-use scenarios in which outdoor activities involve adult construction workers, adult residents engaged in yard work activities and children playing in areas where contaminated soils can be contacted.

There are many studies reporting a wide variety of soil ingestion rates. In general the range values are from 25 to 100 mg per day, as best estimate, up to 100 to 500 mg per day (LaGoy 1987). These values are highly dependent on age and activity. For this Endangerment Assessment values within these ranges were used to represent a reasonable approach.

The USEPA (1988) report average soil ingestion values for 3.5 to 5 year old children as 0.05 grams (50 mg) per day and 0.2 grams (200 mg) per day for 1.5 to 3.5 year old children. These values were used as best estimate and maximum plausible values, respectively, for soil ingestion. The value of 0.5 grams (500 mg) of soil ingested per day for adults was used as a maximum plausible value, this was based on an estimate of outdoor activity involving yard work at eight hours per day (Hawley 1985). A value of 0.2 grams (200 mg) per day was used as the best estimate.

The time of exposure varies with the individual scenarios. Studies by Hill (1985) have shown that outdoor work can range between approximately 15 to 26 hours per week for men and women, therefore the resident that works the soil can be expected to work at least two days per week as a best estimate, and up to four days per week as a maximum plausible. These values were used in calculating time of exposure for soils to resident adults. It was assumed that children were exposed to soils for an equal number of days of outdoor activities. Short-term and long-term exposures for adults were assumed to be 90 days and 70 years, respectively.

During the redevelopment scenario, the potentially exposed persons are assumed to be construction workers who may encounter contaminated soils during redevelopment of the Jasco site and incidentally ingest 200mg (best estimate) to 500 mg (maximum plausible) of soil. Exposure time was conservatively assumed to be eight hours per day, five days per week for both best estimate and maximum plausible over a 90 day period of time. Longer exposures are not anticipated as excavation type activities for construction purposes are not prolonged.

5.2.3 Particulate Inhalation

The inhalation of airborne particulates was assumed to be limited to the future land-use scenarios where construction work is taking place, and/or tending and playing in a residential garden occurs. Air particulate concentrations were estimated based upon monitoring data collected at two residential construction sites in Arizona and Nevada (USEPA 1974). Although not site specific, this estimated value of 0.29 mg/m^3 was considered a conservative estimate of the air particulate concentrations that an individual may encounter at the Jasco site. Of this 0.29 mg/m^3 of particulate concentration, it was considered that 50 percent was respirable [particulate matter the size of 0.5 and 5.0 microns (Wedgman and Levy 1979)] as a best estimate, and 60 percent was respirable for a maximum plausible condition.

The inhalation rates of adults and children vary, depending on the level of activity. A moderate level of activity was assumed for construction workers and adults performing gardening activities. Therefore, adults were assumed to inhale at a rate of 2.6 m^3per hour as best estimate for the average adult (USEPA 1988), and 2.8 m^3 per hour as a maximum plausible. This value was calculated by the USEPA (1988) for an adult male. Children were assumed to undergo heavy activity while playing outdoors and were assumed to inhale at a rate of 2.4 m^3 per hour as best estimate, and 4.2 m^3 per hour as maximum plausible value (USEPA 1988).

The best estimate exposure duration for adults was assumed to be eight hours per day, two days per week. Maximum plausible exposures for adults were assumed to be eight hours per day for four days per week. Children were assumed to be outdoors for 1.5 hours per week (best estimate) and 2.0 hours per week (maximum plausible) (Timmer et. al. 1985). Inhalation of particulates was assumed to occur only half of the time over the 70 year period representing long-term exposure. This assumption accounts for periods of inactivity due to inclimate weather, illness, and any other reason that would preclude outdoor activities. As a conservative estimate it was assumed that short-term exposure to particulate contaminants occurs at every occurrence of outdoor activity. This assumption could be considered reasonable as the short-term 90 day exposure duration can represent the summer months when outdoor activities are frequent.

Both best estimate and maximum plausible exposure durations for construction workers were assumed to be eight hours per day, five days per week. Exposure is expected to be of only short-term duration (90 days), as construction activities are not for extended periods of time.

5.2.4 Inhalation of Vapors While Showering

This section describes the assumptions used to calculate inhalation of volatilized contaminants while showering. This is applicable to the future land-use scenario in which ground water is the source of residential potable water. For the purpose of this Endangerment Assessment showering activities were limited to adults.

As stated in Section 5.2.3 inhalation rates are dependent upon the level of activity of an individual. A light level of activity resulting in an inhalation rate of 1.3 m^3 per hour (USEPA 1988) was assumed for adults while showering. This rate was considered as both a best estimate and maximum plausible value since it was assumed that a light activity level is representative of showering for the entire exposed population.

Studies by Hill (1985) have shown that showering activities can range form 0.5 hours per week (five minutes per day), to 1.2 hours per week (10 minutes per day). These values were used for both best estimate and maximum plausible exposure durations. It was also assumed that showering occurs every day for both short-term and long-term periods.

As a conservative estimate it was calculated that 100 percent of the ground water contaminants are available for inhalation intake during the showering scenario.

5.2.5 Dermal Exposure to Soils

Dermal exposure was assumed to occur in the same intake scenarios as discussed in soil ingestion and particulate inhalation sections. Intakes and subsequent risks resulting from dermal intake were not calculated in this Endangerment Assessment, due to the lack of acceptable methodology for the determination of risks due to dermal exposures.

5.2.6 Dermal Exposure to Water

The dermal exposure to ground water was assumed to occur in the future land-use scenario when ground water is used for showering. Dermal intakes were not calculated for those reasons stated previously in Section 5.2.5.

5.2.7 Inhalation of Vapors, Outside of Residence

Inhalation of contaminants from the volatilization of volatile organic compounds in the soils was assumed to occur in the future land-use scenario in which outdoor activities involve the construction workers, adults, and children.

A highly conservative screening analysis was conducted to determine the potential health risk associated with inhalation exposure from the volatilization of the indicator contaminants in the soils. This analysis is presented in Appendix D and shows that the exposure to air emissions resulting from the volatilization of contaminants of the soils would not pose a significant health risk to the surrounding residents and worker population. The total upper-bound incremental lifetime risk at the point of maximum concentration was calculated to be 5.8×10^{-7} which is at the upper-bound limit of the carcinogenic risk range established by USEPA.

5.3 Intake Analysis

The calculation of intake (mg/kg/day) was completed for both subchronic (90 days) and chronic (70 years) scenarios. The receptor-specific intake rates are presented in Tables D-1 through D-9 in Appendix D. Each table presents the intake rate of a specific contaminant via a specific medium for adult residents, construction workers or children. The calculation of both best estimate and maximum plausible intake rates was completed using the set of parameters described in the preceeding sections. Comparison of these calculations show that the largest oral and inhalation intake value for contaminants is via ground water ingestion by adults and children.

SECTION 6.0
RISK CHARACTERIZATION

6.1 Introduction

This section describes the potential health risks associated with the exposure scenarios developed during the exposure assessment. To characterize the potential risks associated with the Jasco site, the exposure scenarios are integrated with the results of the toxicity assessment.

The potential risks associated with the indicator contaminants were quantified by using the short-term (subchronic) and long-term (chronic) daily contaminant intake. Intake amounts were then compared to published acceptable chronic and subchronic daily intake levels to assess potential non-carcinogenic health effects. Potential lifetime cancer risks were derived by using published carcinogenic potency factors.

In some cases the indicator contaminants exert carcinogenic effects that are of greater concern than the non-carcinogenic effects, or the carcinogenic effects are so severe that research has not substantially differentiated between the two effects when this is the case (e.g. 1,2-Dichloroethane, Benzene, Trichloroethane, and Vinyl Chloride) the Endangerment Assessment addressed the more significant carcinogenic effect. In other cases where research has been able to substantially characterize non-carcinogenic effects and carcinogenic effects for indicator contaminants (e.g. 1,1-Dichloroethene, Methylene Chloride, and Tetrachloroethylene) both non-carcinogenic and carcinogenic risks were calculated. By this rationale, the Endangerment Assessment characterizes non-carcinogenic and carcinogenic risks to the furthest and most practical level available based on the known scientific evidence as presented in the toxicological profiles.

6.2 Non-Carcinogenic Risk Assessment Methodology

For non-carcinogens, the U.S. EPA has calculated acceptable daily intakes for both short and long term. Since short-term (sub-chronic) exposure to relatively high concentrations of chemical contaminants can cause different toxic effects then those caused by long-term (chronic) exposure to lower concentrations, two intake levels are calculated for each chemical, the sub-chronic acceptable intake (AIS) and the chronic acceptable intake (AIC). The acceptable daily intakes are specific to exposure routes, oral and inhalation, and are expressed in mg/kg/day. Acceptable daily intake levels for indicator contaminants used in this assessment were determined by using the USEPA Integrated

Risk Information System (IRIS) (USEPA 1989), and through the aid of Region IX EPA (USEPA 1989a). A summary of oral and inhalation AISs and AICs are listed in Table 6-1.

Once the acceptable reference intake was determined, the hazard indices (HI) were determined by dividing the appropriate calculated intake levels by the appropriate acceptable intake reference level. This comparison results in a ratio of **estimated intake:acceptable intake**. Any chemical with an intake level greater than the acceptable intake levels will cause the HI to exceed unity. When an HI exceeds unity there may be a concern for potential health risks (USEPA 1986). These health risks are discussed in the detailed chemical-specific Toxicological Profiles presented in appendix B. Total hazard indices are based upon the comprehensive levels that may be incurred by an individual. Total hazard indices are calculated by adding the chemical-specific hazard indices together.

6.3 Carcinogenic Risk Assessment Methodology

Carcinogenic Risks were calculated for indicator contaminants that have been identified as being potnetial human carcinogens. This identification process has been performed by the USEPA and is based on current toxicological/epidemiological evidence.

Carcinogenic risk calculations were performed by using individual long-term intake levels of indicator contaminants for both best estimate and maximum plausible, and multiplying them by the appropriate chemical-specific carcinogenic potency factor (CPFs) presented in Table 6-2. The CPF anticipates the probability of occurrence of a lethal cancer within a lifetime and is expressed in units of $(mg/kg_{bodyweight}/day)^{-1}$. This factor is an upper 95 percent confidence limit on probability of response per unit intake of a chemical over a lifetime. Therefore there is only a five percent chance that the probability of a response could be greater than the estimated value on the basis of experimental data used. If the exposure assessment is conservative, the predicted risk is an upper bound estimate. Consequently, the predicted risk may overestimate the actual risk at a site. However, this method is used so that the carcinogenic risk will be underestimated (USEPA 1986).

The resulting product of the CPF x intake is a numerical expression that estimates the excess cancer mortality rate to a population due to intake of a carcinogenic contaminant over a 70 year period. For example, the expression 1×10^{-6} illustrates a potential excess cancer rate to a population to be one in a million attributed to the chemical in question over a 70 year period. The USEPA recognizes an allowable range of carcinogenic risk of 10^{-4} to 10^{-7} after remediation (USEPA 1986).

TABLE 6-1
ACCEPTABLE DAILY INTAKE FOR
INDICATOR CONTAMINANTS
(NON-CARCINOGENIC EFFECTS)

Indicator Contaminant	Oral AIS(1) mg/kg/day	Oral AIC(2) mg/kg/day	Inhalation AIS(1) mg/kg/day	Inhalation AIC(2) mg/kg/day
1,2 DCA	---	---	---	---
1,1 DCE	9.00×10^{-3}	9.00×10^{-3}	---	---
TCE	---	---	---	---
Vinyl Chloride	---	---	---	---
Benzene	---	---	---	---
Tetrachloroethylene	1.0×10^{-2}	1.0×10^{-2}	---	---
Methylene Chloride	6.0×10^{-2}	6.0×10^{-2}	9.0×10^{-1}	9.0×10^{-1}
1,1 DCA	1.0	1.0×10^{-1}	1.0	1.0×10^{-1}
PCP	3.0×10^{-2}	3.0×10^{-2}	---	---

(1) Acceptable subchronic daily intake.
(2) Acceptable chronic daily intake.

TABLE 6-2
CARCINOGENIC POTENCY FACTORS FOR
INDICATOR CONTAMINANTS
(CARCINOGENS)

Indicator Contaminant	Oral Potency Factor $mg/kg/day^{-1}$	Inhalation Potency Factor $mg/kg/day^{-1}$	Source
1,2 DCA	9.1×10^{-2}	9.10×10^{-2}	USEPA 1989
1,1 DCE	6.0×10^{-1}	1.20	USEPA 1989
TCE	1.1×10^{-2}	1.30×10^{-2}	USEPA 1989a
Vinyl Chloride	2.30	2.95×10^{-1}	USEPA 1989a
Benzene	2.9×10^{-2}	2.90×10^{-2}	USEPA 1989
Tetrachloroethylene	5.1×10^{-2}	3.30×10^{-3}	USEPA 1989a
Methylene Chloride	7.5×10^{-3}	1.40×10^{-2}	USEPA 1989
1,1 DCA	9.1×10^{-2}	---	USEPA 1989a
PCP	1.6×10^{-2}	---	USEPA 1989a

6.4 Risk Analysis

This section evaluates the risk to human health that is posed by the Jasco site. Scientific judgement was used to select best estimate values that probably represent actual intakes at and near the Jasco site and maximum plausible intakes that are based on intake estimates that may occur, but are not necessarily representative of conditions associated with the site. As previously stated complete exposure pathways under current land-use conditions do not exist. Therefore health risks associated with current land-use scenario were not calculated. Potential health risks associated with the projected future land-use scenario (residential occupancy) were calculated and are discussed in the following sections.

6.4.1 Ground Water

The possibility that a small domestic well would be drilled into the A-aquifer for a water supply is very small. The ground water is regulated by the Santa Clara Valley Water District with a fee for ground water withdrawal and neither the A or B-aquifer are currently used for domestic purposes in the vicinity of the Jasco site. A summary of results shown on Table E-1 demonstrates that the chronic hazard indices associated with ground water ingestion by adult residents exceeds unity ($HI_{Best\ Estimate}$ = 3.2 and $HI_{Maximum\ Plausible}$ = 3.7). Further analysis of the chemical specific hazard indices reveals that methylene chloride ($HI_{Best\ Estimate}$ = 3.0 and $HI_{Maximum\ Plausible}$ = 3.3) is the main contaminant responsible for the high hazard indice calculated for ground water ingestion by adult residents. Subchronic hazard indices for ground water ingestion by adults (see Table E-2) and children (see Table E-3) are less than one and no adverse effects would be expected to occur.

Chronic and subchronic hazard indices associated with inhalation of vapors while showering by adults are presented in Tables E-4 and E-5. Calculations indicate chronic hazard indices are less than one for both best estimate and maximum plausible values. Subchronic hazard indices were found to be 1.2 (best estimate) and 3.0 (maximum plausible). These excessive hazard indices are due to estimated methylene chloride intakes.

Potential excess cancer risks associated with consuming ground water containing carcinogenic indicator contaminants are shown on Table E-6. Calculations indicate a range from 3.4×10^{-6} for pentachlorophenol (PCP) to 1.4×10^{-3} for methylene chloride as best estimate, and 3.8 X 10-6 for

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REFERENCES

ACGIH (American Conference of Governmental Industrial Hygienists). 1987. TLVs. Threshold Limit Values and Biological Exposure Indices for 1981-1988.

ATSDR (Agency for Toxic Substances and Disease Registry), U.S. Public Health Service, 1988b. Toxicologic Profile for Trichlorethylene. pp 140.

ATSDR, U.S. Public Health Service. 1988a. Toxicological Profile for Tetrachloroethylene. pp 112.

ATSDR, U.S. Public Health Service. 1987. Toxicological Profile for Benzene. pp 182.

ATSDR, U.S. Public Health Service. 1988c. Toxicological Profile for Vinyl Chloride. pp 114.

Aksoy, M., Erdem, S., Erdogan, G., Dincol, G. 1976. Combination of Genetic Factors and Chronic Exposure to Benzene in the Aetiology of Leukemia. Human Heredity. 25, 149 - 153.

Ali, S.M., no date, Fate of trichlorethylene and other pollutants is soil and water, Consultant's report for California Regional Water Quality Control Board - Central Valley Region, Sacramento, California, 50 pp.

Andilman, J.B. 1985. *Inhalation Exposure in the Home to Volatile Organic Contaminants of Drinking Water*. The Science of the Total Environment, 47, pp. 433-460.

Begley, J. 1977. Association between renal function tests and phenochlorophenol exposure. Clinical Toxicology. 11:97-106.

Bionetic Research Laboratories (BRL). 1968. Evaluation of carcinogenic, teratogenic, and mutagenic activities of selected pesticides and industrial chemicals, Volume I, Carcinogenic Study. Report to National Cancer Institute, Bethesda, Maryland.

Buben, J.A., O'Flaherty, E.J., 1985. Delineation of the Role of Metabolism in the Hepatotoxicity of Trichloroethylene and Perchloroethylene: A Dose-Effect Study. Toxicology and Applied Pharmacology. 78,1, 105-122. (cited in ATSDR, 1988b).

Feron, V.J., Speck, A.J., Williams, M.I., Van Buttaum, D., Groct, A.P., 1975. Observations on the Oral Administration and Toxicity of Vinyl Chloride in Rats. Food and Cosmetic Toxicology. 13,6, 633-638. (cited in ATSDR, 1988c).

Fingerhut M.A., W.E. Halperin, P.A. Honcha, et al. 1984. An evaluation of dioxin exposure and soft tissue sarcoma pathology among chemical workers in the United States. Scand J Work Environ. Health 10:299-303.

Foster, S.A. and Chrostowski, P.C. 1987. Inhalation exposures to volatile organic contaminants in the shower. Presented at the 80th Annual Meeting of the Air Pollution Control Association, New York, N.Y., June 21-26, 1987.

Freeze, R.A., and J.A. Cherry, 1979, Groundwater, Prentice-Hall, Inc., Englewood Cliffs, N.J.

Gilbert F.I., G.E. Minn, et al. 1981. Effects of chemical preservatives on the health of wood treating workers in Hawaii, 1981. Clinical and chemical profiles and historical perspective study (unpublished). McLean VA: American Wood Preservers Institute.

Gilham and Cherry, 1982, Contaminant migration in saturated unconsolidated geologic deposits, Recent Trends in Hydrogeology, N.N. Narasimham, ed., Geological Society of America, Special Paper, 189, pp. 31-62.

Goldstein, J.A., M. Friesen, R.E. Linder, P. Hickman, J.R. Hass and H. Bergman. 1977. Effects of pentachlorophenol on hepatic drug-metabolizing enzymes and porphyira related to contamination with chlorinated debenzo-p-dioxins and dibenzoferans. Biochem. Pharmacol. 26:1549-1557.

Greene M.H., L.A. Brinton, J.F. Fraumeni J.F. et al. 1978 Familial and sporadic Hodgkin's disease associated with occupational wood exposure. Lancit. 2:626-627.

Harding Lawson Associates. 1987. *Remedial Investigation/Feasibility Study Middlefield-Ellis-Whisman Study Area, Mountain View, California.* Report submitted to U.S. EPA Region IX on behalf of Fairchild Semiconductor Corporation, Intel Corporation, and Raytheon Company, Volume one. July 1987.

Hawley, J.K., 1988. Assessment of health Risks from Exposure to Contaminated Soils. *Risk Analysis* 5:289.

Healy, T.E., Poole, T.R., Hooper, A. 1982. Rat Fetal Development and Maternal Exposure to Trichloroethylene at 100 ppm. British Journal of Anaesthesiology, 54, 337 - 341. (cited in ATSDR, 1988b).

Helley, E.J., Lajoie, K.R., Spangle, W.E., and Blair, M.L. 1979. "Flatland Deposits - Their Geology and Engineering Properties and Their Importance to Comprehensive Planning", Geological Survey Professional Paper 943, U.S. Government Printing Office 1979.

Hill, M.S., 1985. Patterns of time use. In F.T. Juster and F.P. Stafford (eds) *Times, Goods, and Well-being.* Survey Research Center. Institute of Social Records. University of Michigan, Ann Arbor. pp. 133-166.

ICF - Clement 1988. Final Draft Endangerment Assessment for the Middlefield-Ellis-Whisman Site in Mountain View, California. July 1, 1988. Report submitted to EPA Region IX for Camp Dresser and McKee Inc.

Inside Washington Publishers, 1987. *SARA NCP Refines Controversial "ARAR" Cleanup Standards.* In Inside EPA, November 27, 1987. p. 14.

Johnson, R.L., P.J. Gerhing, R.J. Kociba and B.A. Schwetz. 1973. Clorinated debenzodioxions and pentachlorophenol. Environ Health Perspect., Exp. Issue No. 5, Sept., p. 171-175.

Kerkvliet, N.I., L. Baecher-Steppan, A.T. Claycomb, A.M. Craig and G.G. Sheggeby. 1982. Immunotoxicity of technical pentachlorophenol (PCP-T): Depressed humoral immune responses to T-dependent and T-independent antigen stimulation in PCP-exposed mice. Tundam. Appl. Toxicology. 2(2):90-99.

Kjellstrand, P., Holmquist, B., Alm, P., Kanje, M., Romane, S., Jonsson, J.B., Mannson, L., Bjerkamo, M. 1983. Trichloroethylene: Further Studies of the Effects on Body and Organ Weights and Plasma Butyryl Cholinesterase Activity in Mice. Acta Pharmacol. Toxicol; 53, 375 - 384. (cited in ATSDR, 1988b).

Klemmer, H.W. 1972. Herman Health and Pesticides; Community Pesticide Studies. Residue Review. 41:55-63

Klemmer, H.W. et al., 1980. Clinical fingings in workers exposed to pentachlorophenol. Arch Environ. Contam. Toxicology. 9(6):715-725.

LaGoy, P.K. 1987. *Estimated Soil Ingestion Rates for Use in Risk Assessment.* Risk Analysis. 7(3):355-359.

Larsen, R.V., G.S. Born, W.V. Kessler, S.M. Shaw and D.C. Van Sickle. 1975. Placental transfer and teratology of pentachlorophenol in rats. Environmental Lett. 10:121-128.

Li, G.L., Yin, N., Watanabe, T. 1986. Benzene-Specific Increase in Leukocyte Alkaline Phosphatase Activity in Rats Exposed to Vapors of Various Organic Solvents. Journal of Toxicology and Environmental Health 19.581-989.

Maltoni, C., Lejemine, G., Colti, G. 1986. Experimental Research on Trichloroethylene Carcinogenesis. Archiv. Res. Industrial Carcinogenesis Series. Maltoni, C., Mehlaman, M.A., eds., Vol. V., Princeton Scientific Publishing Co., Inc., Princeton, N.J., pp 393 (cited in ATSDR, 1988b).

Maltoni, C., Cotti, G., Morisi, L., Chieco. P. 1980. Toxicity and Carcinogenicity Report of Institute of Oncology and Tumor Center. Bologna, Italy. (cited in U.S. EPA, 1984d).

McKenna, M.J., Quast, Yahel, H.O., Balmer, M.F., and Rampy, L.W. 1982. Vinylidene Chloride: A Chronic Inhalation Toxicity and Oncogenicity Study in Rats. Toxicology Research Lab., Health and Environmental Sciences, Dow Chemical USA, Midland, MI. (cited in U.S. EPA, 1984d).

Merck Index, Tenth Edition. 1983. Merck and Company Inc., Rahway, N.J.

Murray, F., Nitschke, K., Rampy, L.,Schwetz, B. 1979. Embryotoxicity and Fetotoxicity of Inhaled or Ingested Vinylidene Chloride in Rats and Rabbits. Toxicology and Applied Pharmacology. 48, 189 - 202. (cited in U.S. EPA, 1984d).

NCI (National Cancer Institute). 1977. Bioassay of Tetrachloroethylene for Possible Carcinogenicity. Bathesda, MD: U.S. Department of Health Education and Welfare, Public Health Service, National Institute of Health. DHEW Pub. No. (NIH) 77-813. (cited in ATSDR, 1988a).

NCI (National Cancer Institute). 1978. Bioassay of 1,2-Dichloroethane for Possible Carcinogenicity. NCI Carcinogenesis Technical Report Series No. 55, DHEW Pub. No. (NIH) 78-1361. Government Printing Office, Washington, D.C. (cited in U.S. EPA, 1984c).

NTP (National Toxicology Program). 1986. Toxicology and Carcinogenesis of Tetrachloroethylene (CAS No. 127-18-4) in F344/N rats and B6C3F1 Mice. (Inhalation Studies). National Toxicology Program Tech. Rep. Ser. Issue. 311. (cited in ATSDR, 1988a).

NTP (National Cancer Institute/National Toxicology Program). 1982. NTP Technical Report on the Carcinogenesis Bioassay of Vinylidene Chloride in F344/N Rats and B6C3F1/Mice (Gavage Study). NTP No. 80-82. NIH Publ. No. 82-1784. NTP, Research Triangle Park, NC and Bathesda, MD. U.S. DHHS, PHS, National Institute of Health. (cited in U.S. EPA, 1984d).

NTP (National Toxicology Program) Technical Report on the Toxicology and Carcinogenesis Studies of Pentachlorophenol (CAS No. 87-5) in B6C3FI Mice. NTP TR349. Publication No. 86-2804.

Narasimhan, N.N., 1982, Physics of saturated-unsaturated subsurface flow, Recent Trends in Hydrogeology, N.N. Narasimhan, ed., Geological Society of America, Special Paper, 189, pp. 3-24.

Oh, N.G., Story, L.K., Holder, B.B., Bronson, J.M., Williams, P.R., 1983. Health Evaluation of Employees Occupationally Exposed to Methylene Chloride. Mortality. Scand. J. Work Environ. Health. 9,1, 8-16. (cited in U.S. EPA, 1984f).

Olson, J. 1989. EPA Environmental Criteria and Assessment Office, Cincinnati, Ohio. Personal Communication, February 21, 1989.

Questa Engineering Corporation, Preliminary Ground Water Investigation, June 1984.

Questa Engineering Corporation, Jasco Monitoring Well V-2, October 20, 1986.

Questa Engineering Corporation, Installation of Well V-3, Permeability Studies, Soil and Ground Water Sampling and Analysis, December 5, 1986.

Roberts, H.G. 1983. Aplastic anemia and cell aplasia due to pentachlorophenol. South Med J. 76:45-48.

Robinson C., D. Fowler, D. Brown, et al. 1985. Plywood mill workers' mortality, 1945-1977. Standford Research Institute, Menlo Park, CA.

Sandmeyer, E.E. 1981. Aromatic Hydrocarbons. In: Patty's Industrial Hygiene and Toxicology. Vol. 2. 3rd Rev. ed., Clayton. G.D., Clayton, F.E., eds. New York: Interscience Publishers. pp. 3253 - 3283.

Schwetz, B.A., J.F. Quast, P.A. Keeler, C.G. Humiston and R.J. Kociba. 1978. Results of two-year toxicity and reporductive studies on pentachlorophenol in rats. In: Pentachlorophenol, Chemistry, Pharmacology and Environmental Toxicology, R.R. Ras, Ed. Plenum Press. New York p. 301.

Schwetz, B.A., Leong, B.K.J., Gehring, P.J. 1974. Embryo- and Fetotoxicity of Inhaled Carbon Tetrachloride, 1,1-Dichloroethane, and Methyl Ethyl Ketone in Rats. Toxicol. Appl. Pharmocology 20, 452-464. (cited in U.S. EPA, 1984b).

Spencer, H.C., Rowe, V.K., Adams, E.M., McCollister, D.D., Irish, D.D. 1951. Vapor Toxicity of Ethylene Dichloride Determined by Experiments on Laboratory Animals. Industrial Hygiene and Occupational Medicine. 4, 482-499. (cited in U.S. EPA, 1984c).

Timmer, S.G.; Eccles, J.; O'Brien, K.; 1985. How Children Use Time. In F.G. Juster and F.P. Stafford (eds). *Time, Goods and Well-Being*. Survey Research Center Institute for Social Research, University of Michigan, Ann Arbor. pp. 353-380.

Tucker, A.N., Sanders, V.M., Barnes, D.W., 1982. Toxicology of Trichloroethylene in the Mouse. Toxicology and Applied Pharmacology. 62, 351 - 357. (cited in ATSDR, 1988).

USEPA. 1983. Reportable Quantity for Dichloromethane. Prepared by the Environmental Criteria and Assessment Office, Cincinnati, OH, for the Office of Solid Waste and Emergency Response, Washington, D.C. (cited in U.S. EPA, 1984f).

USEPA. 1984b. Health Effects Assessment of 1,1-Dichloroethane. pp 25.

USEPA. 1984c. Health Effects Assessment for 1,2-Dichloroethane. pp 44.

USEPA. 1984d. Health Effects Assessment for 1,1-Dichloroethylene. pp 33.

USEPA. 1984e. Health Effects Assessments of Methylene Chloride. pp 48.

USEPA. 1984f. Health Effects Assessments of Pentachlorophenol. pp 1.

USEPA. 1986. Superfund Public Health Evaluation Manual. Washington, D.C. 20460. OSWER Directive 9285.4-1.

USEPA. 1986a. Guidelines for the Health Risk Assessment of Chemical Mixtures. Fed. Reg. 51:34013-34023.

USEPA. 1987b. National primary drinking water regulations - synthetic organic chemicals; monitoring for unregulated contaminants; final rule. Fed. Reg. 52:25690-25717 (July 8, 1987).

USEPA. 1988. *Superfund Exposure Assessment Manual*. OSWER Directive 9285.5-1

Vogel, T.M. and McCarty, P.L. 1985. Biotransformation of tetrachloroethylene to trichloroethylene, dichloroethylene, vinyl chloride, and carbon dioxide under methanogenic conditions. Applied Environmental Microbiology. 49:1080-1083.

Ward, C.O., Kuna, R.A., Snyder, N.K., Alsaker, R.D., Coate,W.B., Craig, P.H. 1985. Subchronic Inhalation Toxicity of Benzene in Rats and Mice. American Journal of Industrial Medicine. 7, 457 - 473.

Wahler Associates, Preliminary Report Shallow Soil Gas Investigation, December 1986

Wahler Associates, Phase I Ground Water Investigation Work Plan, March 4, 1987.

Wahler Associates, Chemical Testing Results, Collection Sump, April 27, 1987.

Wahler Associates, Phase I Hydrogeologic Investigation, June 1987.

Wahler Associates, Site Inspection Report, June 1987.

Wahler Associates, On-Site Source Identification Investigation, July 1987.

Wahler Associates, Well Location Maps, July 30, 1987.

Wahler Associates, Collection and Disposal of Surface Runoff, September 16, 1987.

Wahler Associates, On-Site Runoff Management, November 2, 1987.

Wahler Associates, Phase II Hydrogeologic Investigation, November 1987.

Wahler Associates, Aquifer Testing Report, December 21, 1987.

Wahler Associates, Quality Assurance/Quality Control Project Plan, December 1987.

Wahler Associates, Sampling Plan, December 1987.

PCP and 1.5×10^{-3} for methylene chloride for maximum plausible values. Cumulative carcinogenic risks associated with ground water ingestion are 3.6×10^{-3} for Best Estimate and 4.0×10^{-3} Maximum Plausible values. Calculation of lifetime cancer risks associated with inhalation of vapor by adults while showering are presented in Table E-7 and show potential excess cancer risk of 2.7×10^{-4} for best estimate and 5.9×10^{-4} maximum plausible values. Methylene chloride presents the highest potential cancer risk for both best estimate and maximum plausible values with potential risks of 1.0×10^{-4} and 2.9×10^{-4} respectively.

6.4.2 Soils

Potential exposure to contaminated soils via incidental ingestion and fugitive dust inhalation by construction workers may occur as a result of on-site construction activities during redevelopment of the Jasco property. On-site residents including children may also become exposed to contaminated soils during gardening activities and playing. The likelihood of the above scenarios being carried out is highly probable since the area surrounding the site is residential and the site property was rezoned residential in 1983 and Jasco is required to vacate the premises by 1992.

Chronic and subchronic hazard indices for contaminated soil ingestion by on-site adult residents are presented in Tables E-8, and E-9. Subchronic hazard indices for children and construction workers are shown in Table E-10 and E-11, respectively. Calculations demonstrate that cumulative hazard indices for all receptors are much less than unity and therefore toxic effects are assumed to be negligible. Cumulative potential excess cancer risks presented by ingestion of contaminated soils by adults are shown on Table E-12 and indicate potential excess cancer risks of 7.3×10^{-7} and 3.7×10^{-6} for best estimate and maximum plausible values, respectively.

Hazard indices for chronic and subchronic fugitive dust inhalation by on-site residents are presented in Tables E-13 and E-14. Subchronic hazard indices associated with fugitive inhalation by children and construction workers are shown in Table E-15 and E-16, respectively. Results indicate that all hazard indices values are substantially less than unity for all receptors and therefore potential non-carcinogenic health risks associated with exposure to contaminated fugitive dust Therefore no adverse health effect would be expected. Cumulative potential cancer risks associated with inhalation of contaminated fugitive dust by adults are presented in Table E-17 and show potential cancer risk of 6.5×10^{-9} for best estimate and 1.7×10^{-8} for maximum plausible values.

6.4.3 Conclusion

Chronic and subchronic hazard indices were calculated for total daily ingestion of indicator contaminants via ingestion of ground water combined with incidental ingestion of contaminated soils by adults (see Table E-18). Chronic hazard indices for total daily ingestion exceed unity with 3.4 for best estimate and 3.7 for maximum plausible values. Comparison to hazard indices calculated for ground water ingestion (Table E-1) and soil ingestion, (Table E-8) shows that ground water ingestion in particular the ingestion of the contaminant methylene chloride, poses the adverse health effects associated with chronic ingestion of indicator contaminants. Subchronic hazard indices for total daily ingestion of indicator contaminants are less than one for both best estimate and maximum plausible values. Therefore no adverse health effects would be expected.

Chronic and subchronic hazard indices for total daily inhalation of indicator contaminants by way of inhalation of vapors while showering combined with inhalation of contaminated fugitive dust by adults are shown on Table E-19. Calculations indicate hazard indices of less than one for both chronic and subchronic intake values and therefore adverse health effects would be assumed to be negligible.

Table E-20 presents a summary of subchronic hazard indices calculated for total daily ingestion (ingestion of both ground water and contaminated soils) and total daily inhalation (inhalation of contaminated fugitive dust) of indicator contaminants by children. Results indicate that through ingestion hazard indices are substantially greater than one for both best estimate and maximum plausible values. These excessive hazard indices result form the consumption of contaminated ground water by a 17 kg child. Contaminant specific analysis indicates that the intake of methylene chloride under the best estimate assumptions is 6.7. All other best estimate hazard indices are below unity. For the maximum plausible intake assumptions, 1,1-DCE, tetrachloroethylene, and methylene chloride, all have hazard indices substantially excessive of unity (21, 25, and 850 respectively).

Subchronic hazard indices for total daily ingestion (ingestion of contaminated soils) and total daily inhalation (inhalation of fugitive dust) by construction workers are summarized in Table E-21. Calculations indicate hazard indices of considerably less than one for both exposure pathways. Therefore no adverse health effects would be expected from exposure to either pathway.

Table E-22 includes a summary of the potential lifetime cancer risks associated with total daily ingestion. Total daily ingestion includes ground water ingestion combined with soil ingestion. Results show potential lifetime cancer risks of 3.7×10^{-3} for best estimate and 4.1×10^{-3} for maximum plausible values. When potential lifetime cancer risks for total daily ingestion are compared to potential cancer risks calculated for ground water ingestion (Table E-16) and soil ingestion (Table E-12) it is evident that ingestion of ground water poses the greatest potential lifetime cancer risks.

Potential lifetime cancer risks associated with total daily inhalation of indicator contaminants are also included on Table E-22. Total daily inhalation includes inhalation of vapors while showering combined with inhalation of fugitive dust. Calculations indicate potential lifetime cancer risks of 2.5×10^{-4} for best estimate 6.4×10^{-4} for maximum plausible values. Comparison between the calculated potential lifetime cancer risks associated with total daily inhalation of indicator contaminants to individual potential cancer risks calculated for inhalation of vapors (Table E-7) and inhalation of fugitive dust (Table E-17) shows that the potential cancer risk associated with inhalation of fugitive dust is minimal as compared to inhalation of vapors while showering.

SECTION 7.0
CONCLUSIONS

This section presents the conclusions of the Endangerment Assessment which are listed below. It was determined that the only complete exposure pathway associated with current land-use of the Jasco site was employee and trespasser exposure via inhalation of volatilized contaminants originating in the soils. A screening analysis, using a worse-case scenario indicates a potential carcinogenic risk of 5.8×10^{-7} which is within the USEPA allowable carcinogenic risk range of 10^{-4} to 10^{-7} after remediation.

Separate estimates of the potential for carcinogenic risk and non-carcinogenic risk were calculated for each exposure scenario associated with potential future land-use (residential occupancy) of the site. Risk calculations were made for representative concentrations (best estimate) of the contaminants and for the highest measured contaminant concentrations (maximum plausible). As a result each scenario is associated with four risk calculations: best estimate - carcinogenic; maximum plausible - carcinogenic; best estimate - non-carcinogenic; maximum plausible - non-carcinogenic. The findings were as follows.

1) Significant carcinogenic risks were calculated for both best estimate and maximum plausible values associated with ground water (A-aquifer) consumption and inhalation of ground water vapors.

2) Significant non-carcinogenic risks were calculated for ground water ingestion using best estimate and maximum plausible contaminant concentration levels.

3) There is no significant carcinogenic risk or non-carcinogenic risk associated with exposure to on-site contaminated soils via incidental ingestion or fugitive dust inhalation.

The risk characterization step focused upon human health effects and risks due to the chemical properties of each of the indicator contaminants considered. The results of the risk characterization process were expressed in hazard indices for non-carcinogenic effects and risk levels for carcinogenic effects. For this assessment a hazard index exceeding unity and a risk level exceeding 1×10^{-6} was considered to pose a potential health threat.

Best estimate and maximum plausible hazard indices indicate that chronic and subchronic health effects are not expected as a result to exposure to media containing indicator contaminants for inhalation and ingestion pathways except for chronic daily ingestion of ground water.

The carcinogenic risks were estimated by considering those contaminants for which carcinogenic potency factors have been developed. Under these conditions best estimate carcinogenic risks of greater than 1 X 10^{-6} were calculated for ground water ingestion (3.6 X 10^{-3}) and ground water vapor inhalation (2.7 X 10^{-4}) scenarios.

For ground water ingestion and inhalation pathways it is important to point out that the non-carcinogenic risk and carcinogenic risk are largely dependent upon the concentration of methylene chloride in the water.

The uncertainties associated with the risks at the Jasco site relate to the procedures and inputs used in the assessment. Uncertainties can result from the use of conservative assumptions which is often the case in exposure assessments where data is lacking. Assumptions made in the process of developing the Endangerment Assessment are noted within the report and have resulted in areas of uncertainty. The identified uncertainties are as follows.

1) The results generated by the ground water modeling are based on limited field data without adequate field data describing the subsurface system models cannot predict exposure point concentrations with complete accuracy. In light of these difficulties assumptions were made to evaluate contaminant migration and exposure point concentrations. The application of these assumptions resulted in conservative estimates of exposure point concentrations and subsequent risk estimates.

2) The use of the highest recorded contaminant data as exposure point concentrations is another area of uncertainty. It is unlikely that high value data realistically represents the concentration that will be encountered by the public.

3) The potential difference between detection limit values used in the assessment and the actual contaminant data is another source of uncertainty that effects the conclusion that a significant risk exist.

4) Additional conservativeness is associated with the derivation of critical toxicity values from a limited number of study results (i.e. data extrapolated from animal studies to predict potential health effects of a chemical in human).

Wahler Associates, Site Health and Safety Plan, December 1987.

Wahler Associates, Proposal for Potential Conduit Investigation, December 1987.

Wahler Associates, Installation of Diesel Tank Monitoring Well, December 30, 1987.

Wahler Associates, Excavation and Removal of Diesel Tank, February 8, 1988.

Wahler Associates, Interim Runoff Management Plan, February 29, 1988.

Wahler Associates, Phase IIa Hydrogeologic Investigation, March 1988.

Wahler Associates, Potential Conduits Investigation Preliminary Report, March 1988.

Wahler Associates, Potential Conduits Investigation, May 1988.

Wahler Associates, Surface Water and Soil Sampling Investigation, May 6, 1988.

Wahler Associates, Destruction of Dry Wells, June 9, 1988

Wahler Associates, Evaluation of Interim Remedial Alternatives, Volume 1 and 2, June 1988.

Wahler Associates, Monthly Status Reports to California Regional Water Quality Control Board (CRWQCB), March 1987. to July 1988.

Wegman, D.H.; Levy, B.S. 1979 *Occupational Health Recognizing and Prevention of Work Related Disease*. Little, Brown and Company. Boston. pp. 526.

ENVIRONMENTAL PROTECTION AGENCY
TECHNICAL ENFORCEMENT SUPPORT
AT
HAZARDOUS WASTE SITES

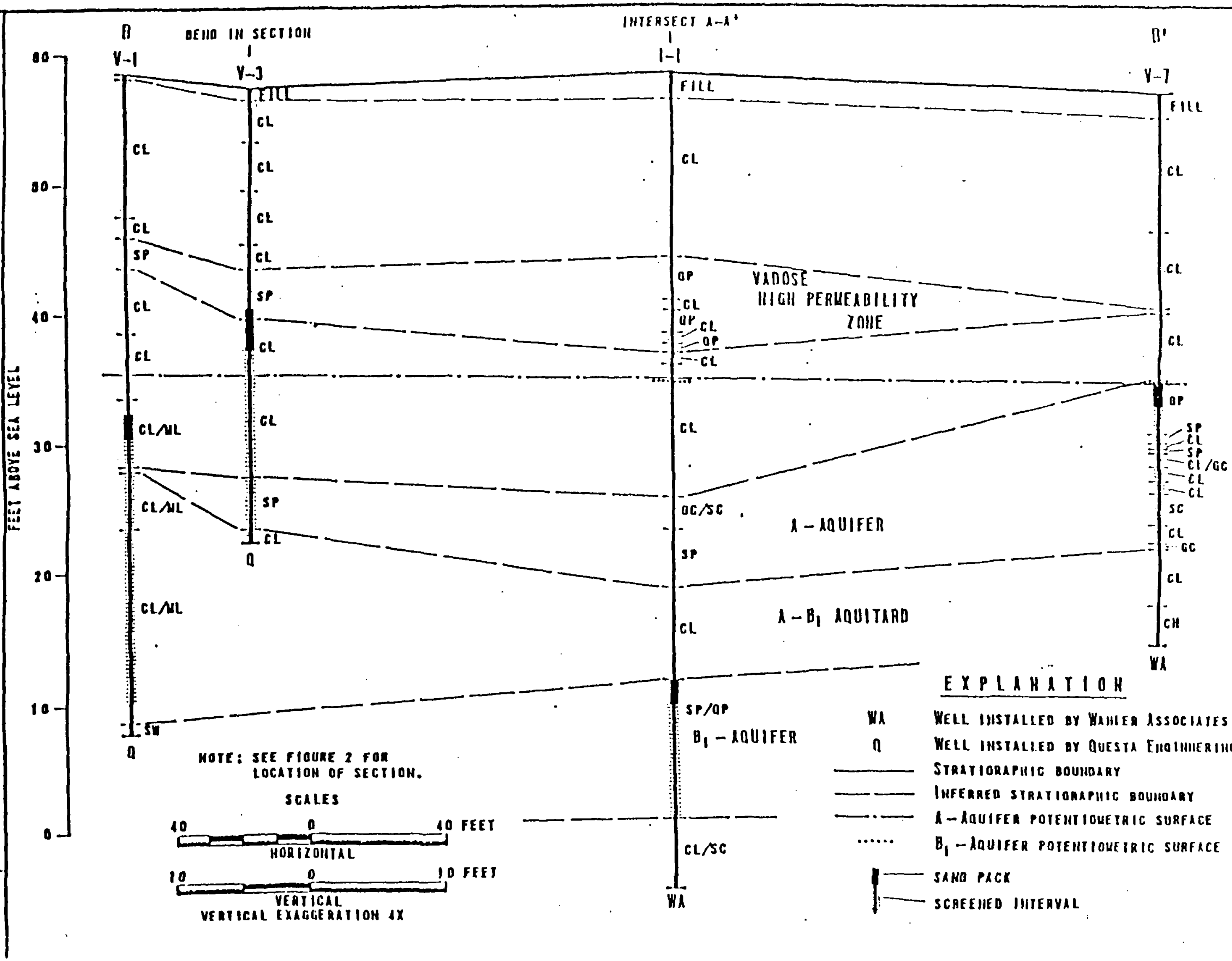
TES IV
CONTRACT NO. 68-01-7351
WORK ASSIGNMENT NO. C09008
ENDANGERMENT ASSESSMENT
FOR
JASCO CHEMICAL CORPORATION
MOUNTAIN VIEW, CA
EPA REGION IX
SITE ACCOUNT NUMBER: 9BF6

JACOBS ENGINEERING GROUP INC.

PROJECT NUMBER 05-B810-00

AUGUST 1989

LOCAL HYDROGEOLOGY FIGURES



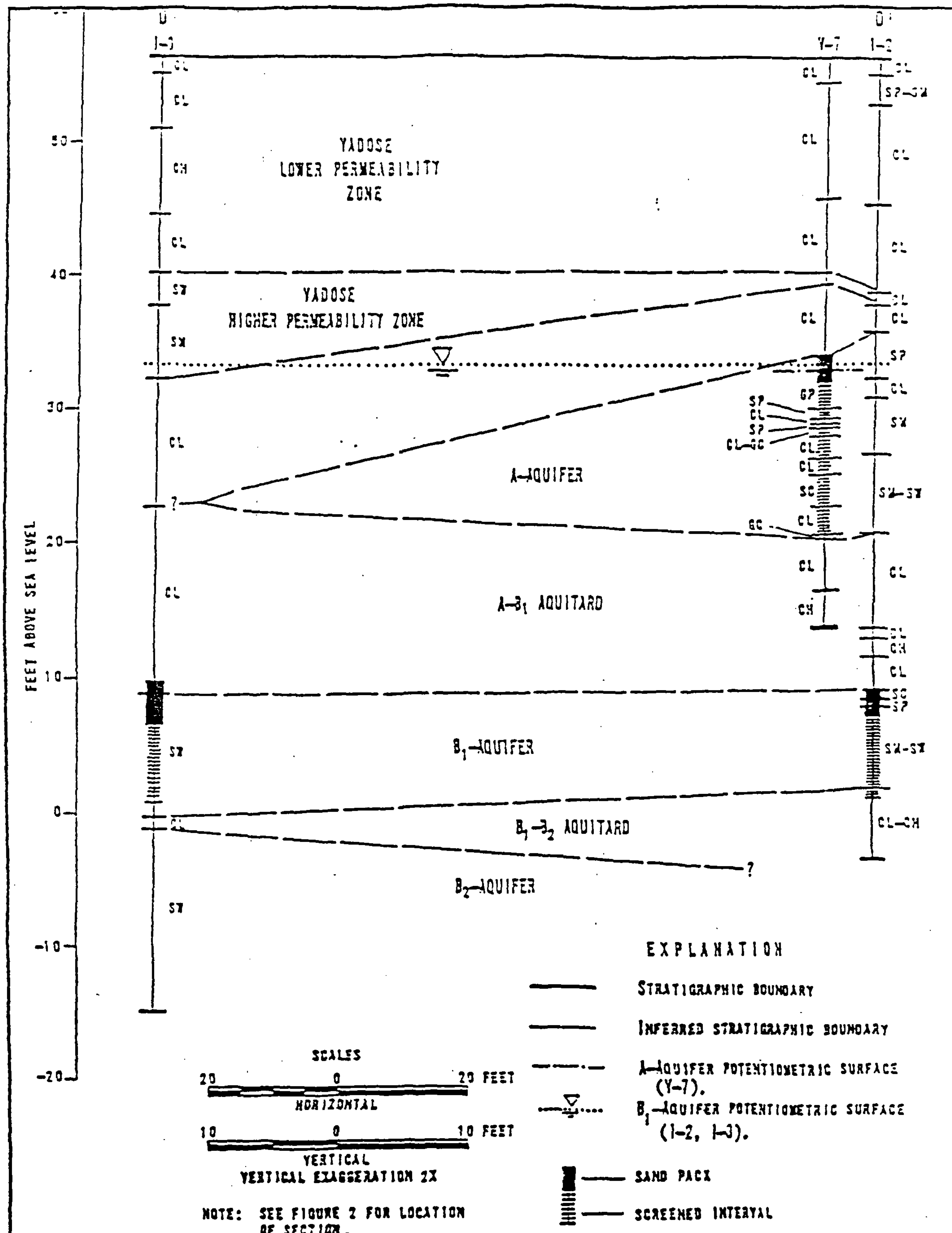
JE JACOBS ENGINEERING GROUP INC.

JASCO CHEMICAL CORPORATION
MOUNTAIN VIEW, CALIFORNIA

GEOLOGIC CROSS SECTION B - B'

Source: Wahler & Assoc.

FIGURE A-1



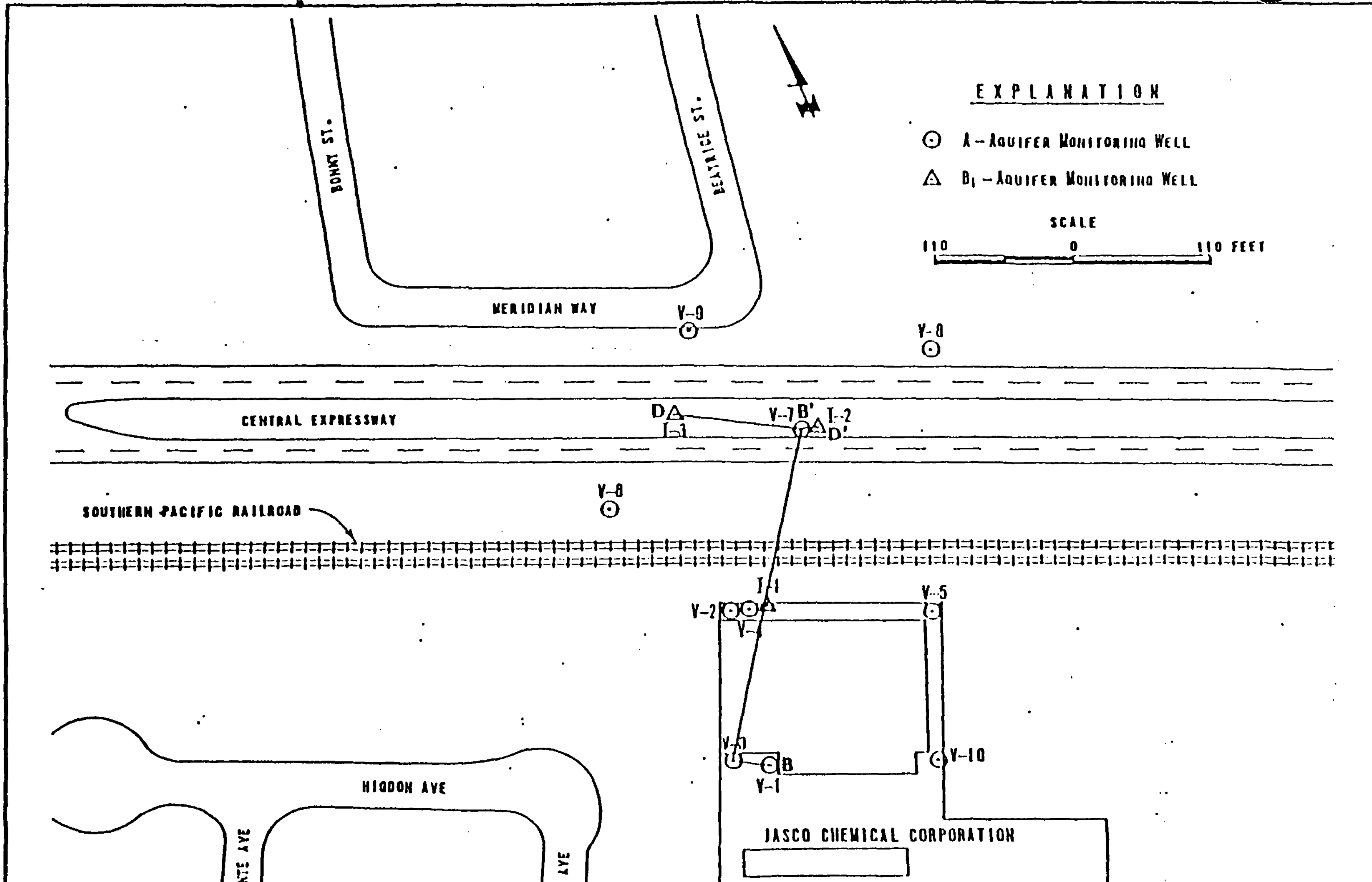
JASCO CHEMICAL CORPORATION
MOUNTAIN VIEW, CALIFORNIA

JE JACOBS ENGINEERING GROUP INC.

GEOLOGIC CROSS SECTION D - D'

Source: Wahler Assoc.

FIGURE A-2



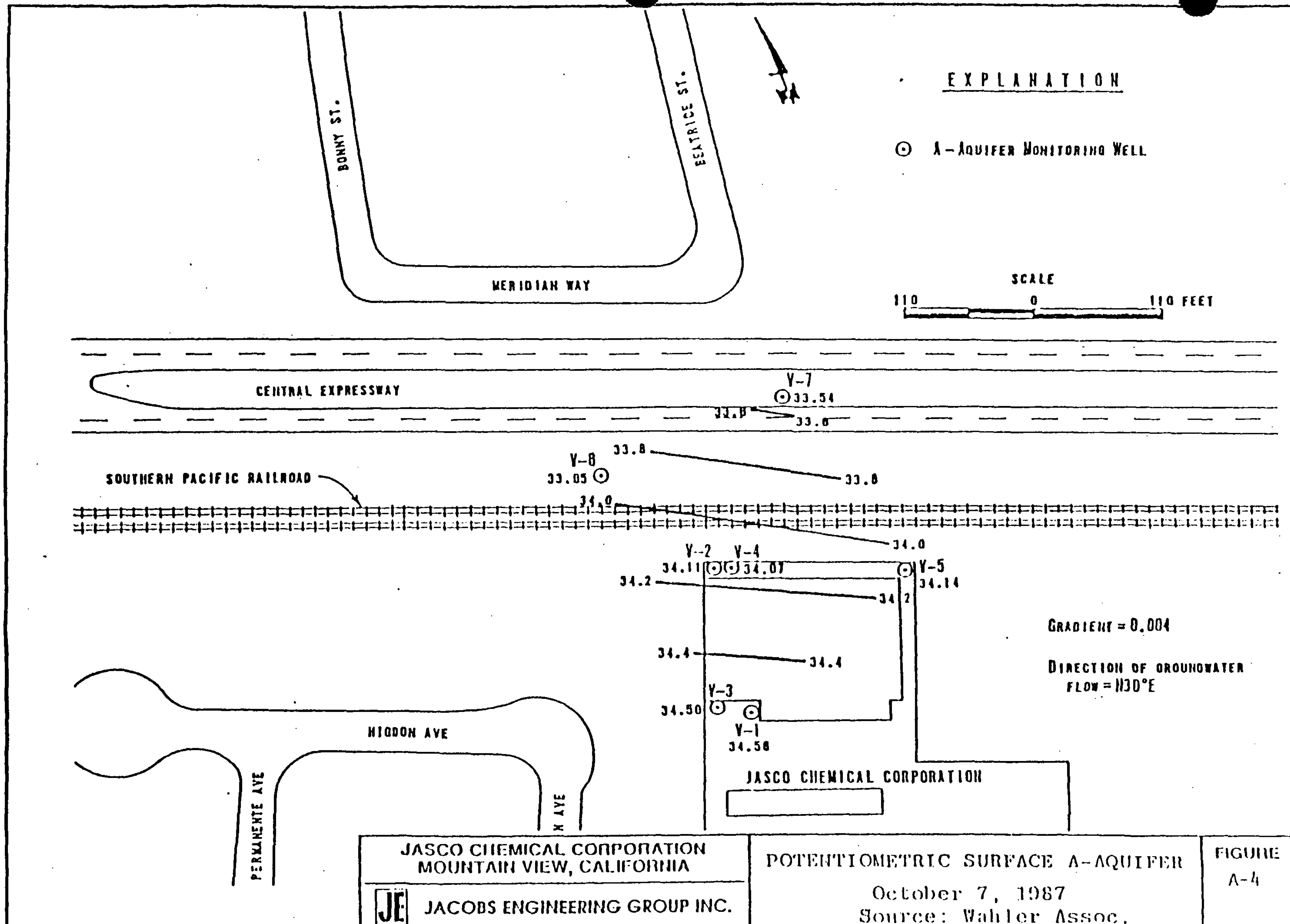
JASCO CHEMICAL CORPORATION
MOUNTAIN VIEW, CALIFORNIA

JE JACOBS ENGINEERING GROUP INC.

LOCATION OF MONITORING WELLS AND GEOLOGIC CROSS SECTIONS

Source: Wahler Assoc.

FIGURE A-3



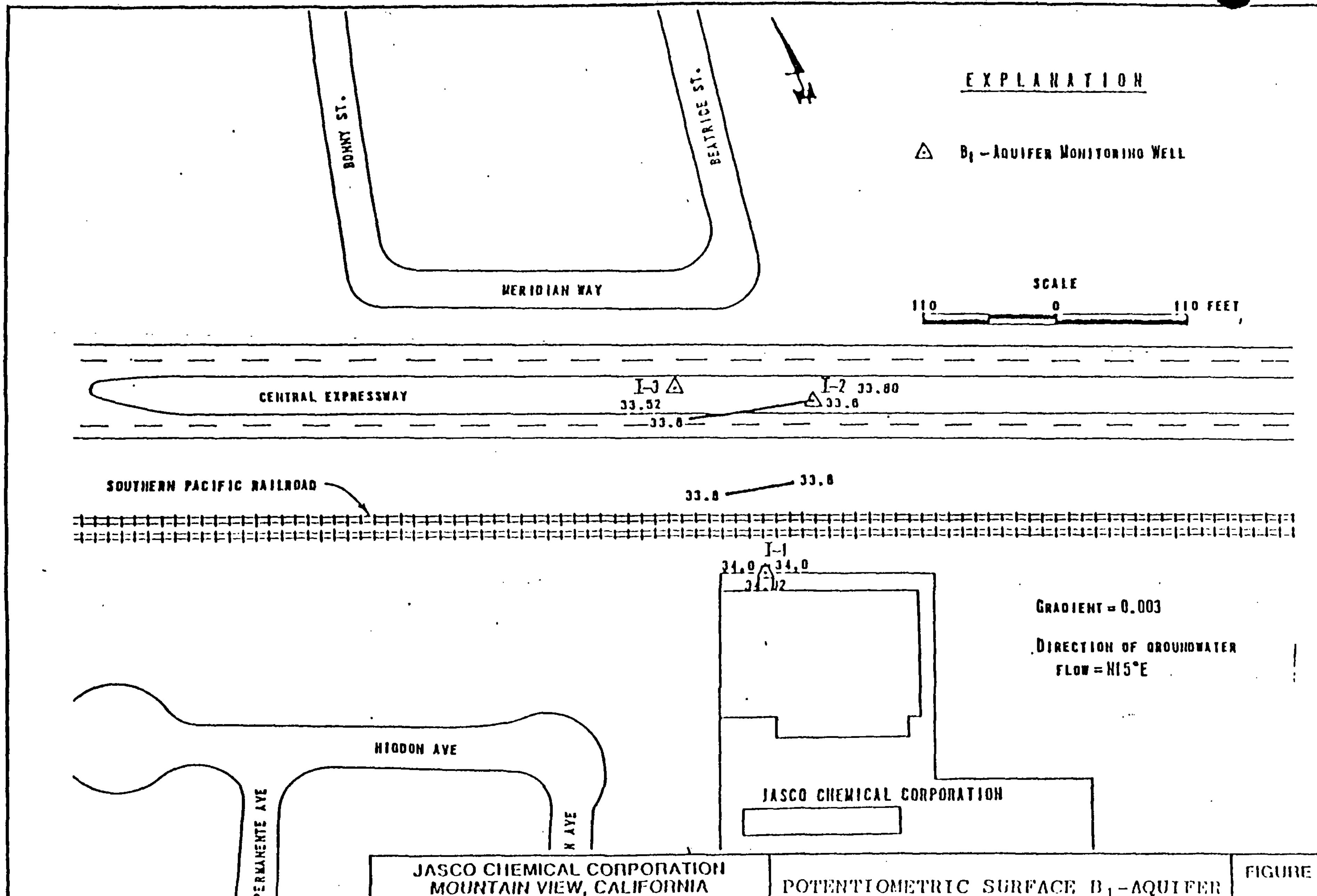
JASCO CHEMICAL CORPORATION
MOUNTAIN VIEW, CALIFORNIA

JACOBS ENGINEERING GROUP INC.

POTENTIOMETRIC SURFACE A-AQUIFER

October 7, 1987
Source: Wahler Assoc.

FIGURE
A-4



JASCO CHEMICAL CORPORATION MOUNTAIN VIEW, CALIFORNIA JACOBS ENGINEERING GROUP INC.	POTENTIOMETRIC SURFACE B_1-AQUIFER October 7, 1987 Source: Wahler Assoc.	FIGURE A-5

REGIONAL GEOLOGY

REGIONAL GEOLOGY

The following description of the regional geology and hydrogeology is modified from the Endangerment Assessment for the Middlefield-Ellis-Whisman Site in Mountain View, California, prepared for Camp Dresser & McKee, Inc. by ICF-Clement, July 1, 1988.

The depositional history within the San Francisco Bay depression is geologically very young (less than two to three million years old). Deposition along the flanks of this depression, which includes the Jasco site, was largely controlled by repeated variations in sea level. These changes in sea level were associated with the cyclic advance and retreat of continental ice during the last ice age which ended approximately 15,000 years ago. Sediments found in the study area are the result of alluvial fan, interfluvial and estuarine processes.

Generally, during periods of low sea level, the ancestral Bay Area depression was the site of sediment accumulation from the surrounding highlands to the west and east. The streams originating in the surrounding hills deposited relatively coarse-grained alluvial fan material along the flanks of the bay. With respect to the Jasco site, these alluvial deposits are generally coarser towards the southwest (toward their source, the Santa Cruz Mountains).

During periods of high sea level, the Bay Area depression was flooded, and fine-grained estuarine sediments (deposited in intertidal zones) were incised by stream channels, which deposited irregularly emplaced coarse-grained materials. During subsequent periods of high sea level, finer-grained sediments were deposited in the existing stream channels. This irregular pattern of sediment accumulation was further enhanced by stream-braiding, flood-plain and levee building, and the deposition of alluvial fans.

This depositional history has resulted in an extremely complex sedimentary sequence characterized by irregular interbedding and interfingering of coarse and fine-grained deposits. These deposits exhibit a large degree of variability in both thickness and lateral continuity. Included with these deposits are buried stream channels that formerly drained from the Santa Cruz Mountains; the channel deposits interfingering with the estuarine deposits along the fringes of the Bay.

Although these stream channels are generally oriented from south to north, other orientations may be present locally.

It is unclear to what extent the basin level was modified by tectonic processes during the Pleistocene. However, the region is currently considered tectonically active, and tectonics probably influenced Quaternary sedimentation within the primordial Santa Clara Valley.

REGIONAL HYDROGEOLOGY

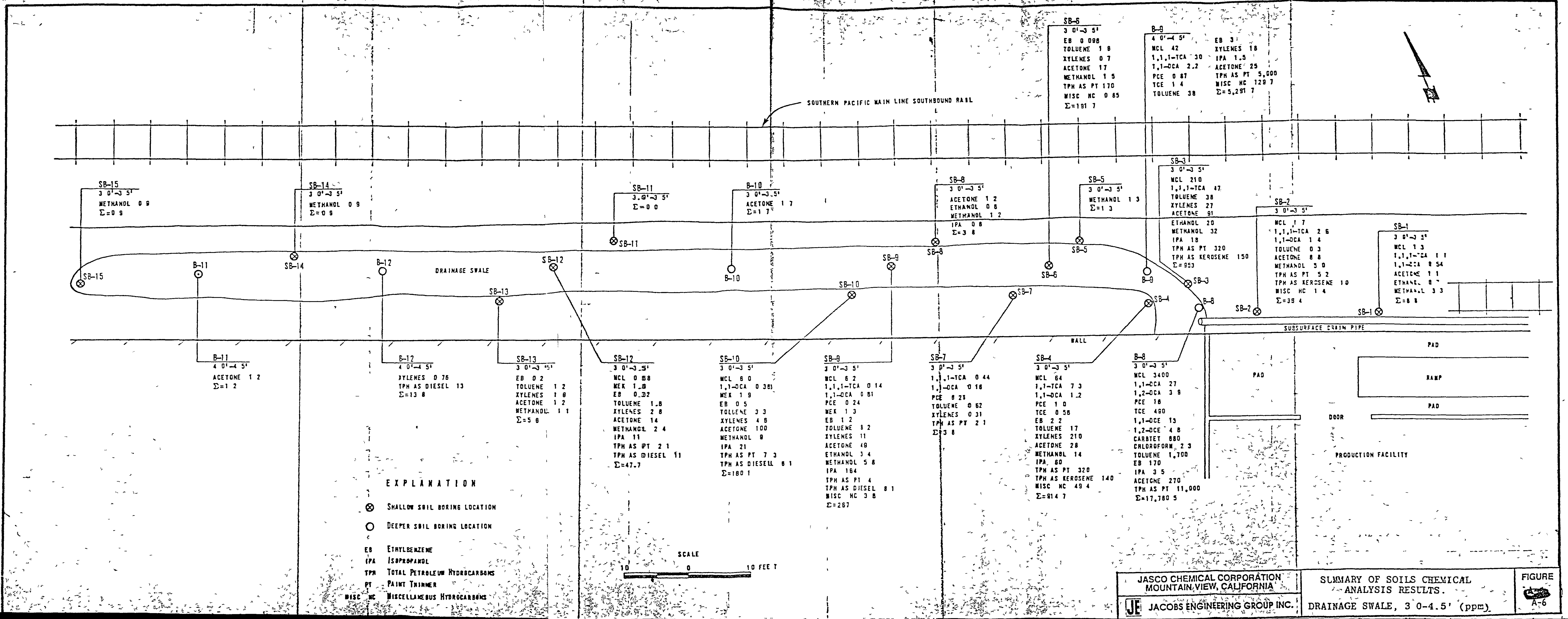
REGIONAL HYDROGEOLOGY

The fine-grained estuarine deposits are considered by Helley to have formed the current regional aquitards. In turn, the coarse-grained alluvial and fluvial deposits constitute the regional aquifers. Significant aquitards could also have developed in response to the formation of marshes along the lower section of alluvial fans. At times these alluvial marshes may have been gradational with estuarine marshes to the north. It is considered by Iwamura and Helley that fine-grained marsh deposits did not significantly extend beyond today's El Camino Real. This has been determined by the lack of regional aquitards between the base of the Santa Cruz Mountains and a line drawn at El Camino Real.

Hydrologic anisotropy of ground water flow has resulted from the complex regional depositional processes. Within the alluvial fan (coarse-grained) deposits of Santa Clara Valley, the direction of preferred flow (maximum anisotropy) is northward. Dip of the maximum anistropy vector would be roughly parallel with the ancestral structural basin at depth, with a decrease in dip upwards until the angle of repose for the alluvial fan is achieved. Anisotropy occurs within the upper- and mid-fan environment as a result of numerous fine-grained overbank deposits covering coarser-grained channel deposits after lateral shifting of alluvial stream channels. The maximum anisotropy associated with fluvial deposits of the Santa Clara Valley Basin is along the axis of channel deposition.

Anisotropy within the lower-fan and estuarine marsh (finer-grained) deposits occurs because these deposits create confining layers between the coarser-grained deposits associated with alluvial and fluvial processes. This is characteristic of the area between El Camino Real and the approximate edge of the current San Francisco Bay. In this region, the preferred flow direction is parallel to layers of fine-grained material.

DISTRIBUTION OF CHEMICALS DETECTED IN SOILS AND GROUND WATER

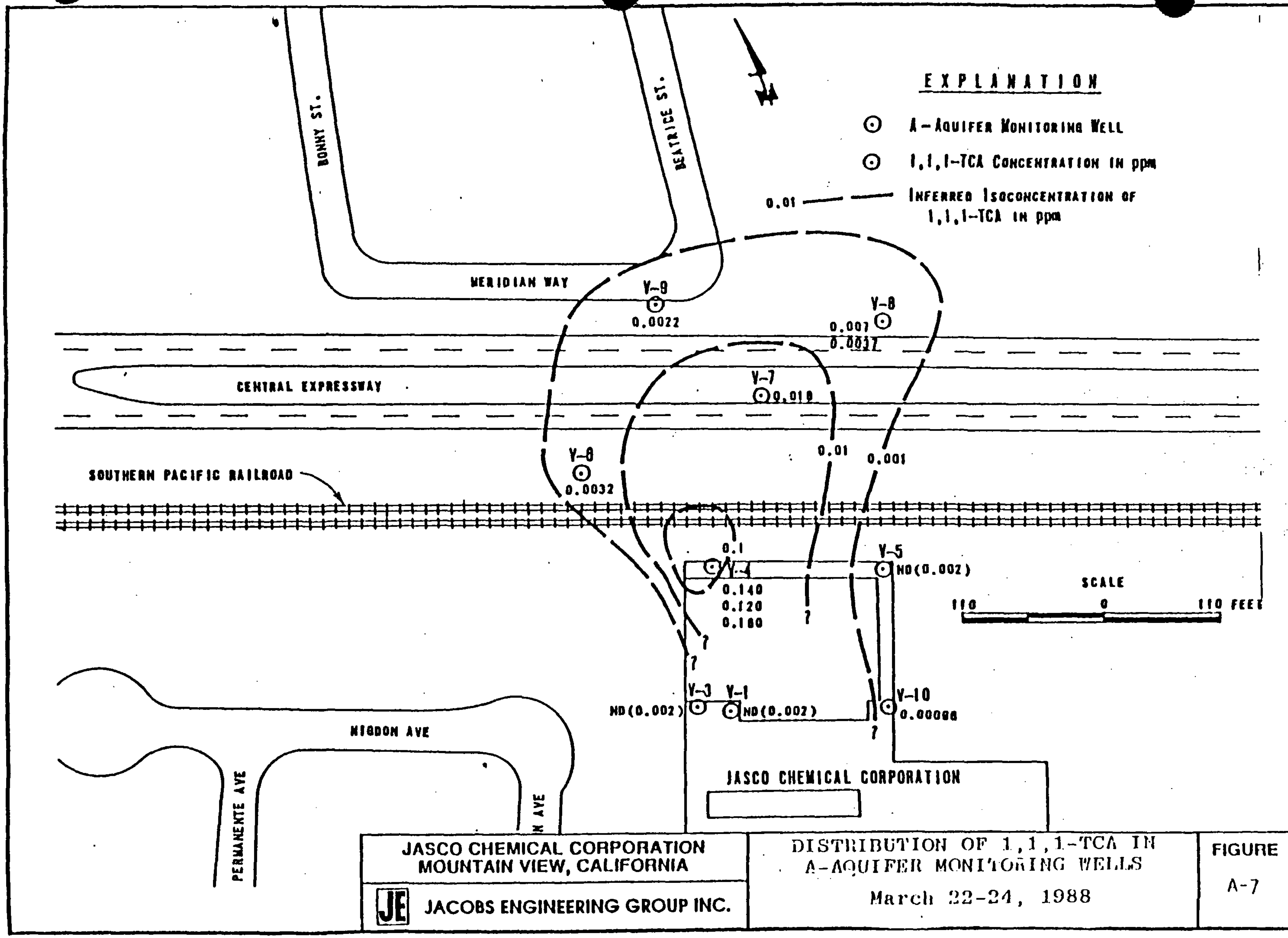


JASCO CHEMICAL CORPORATION
MOUNTAIN VIEW, CALIFORNIA

JE JACOBS ENGINEERING GROUP INC.

SUMMARY OF SOILS CHEMICAL ANALYSIS RESULTS.
DRAINAGE SWALE, 3 0-4.5' (ppm)

FIGURE A-6



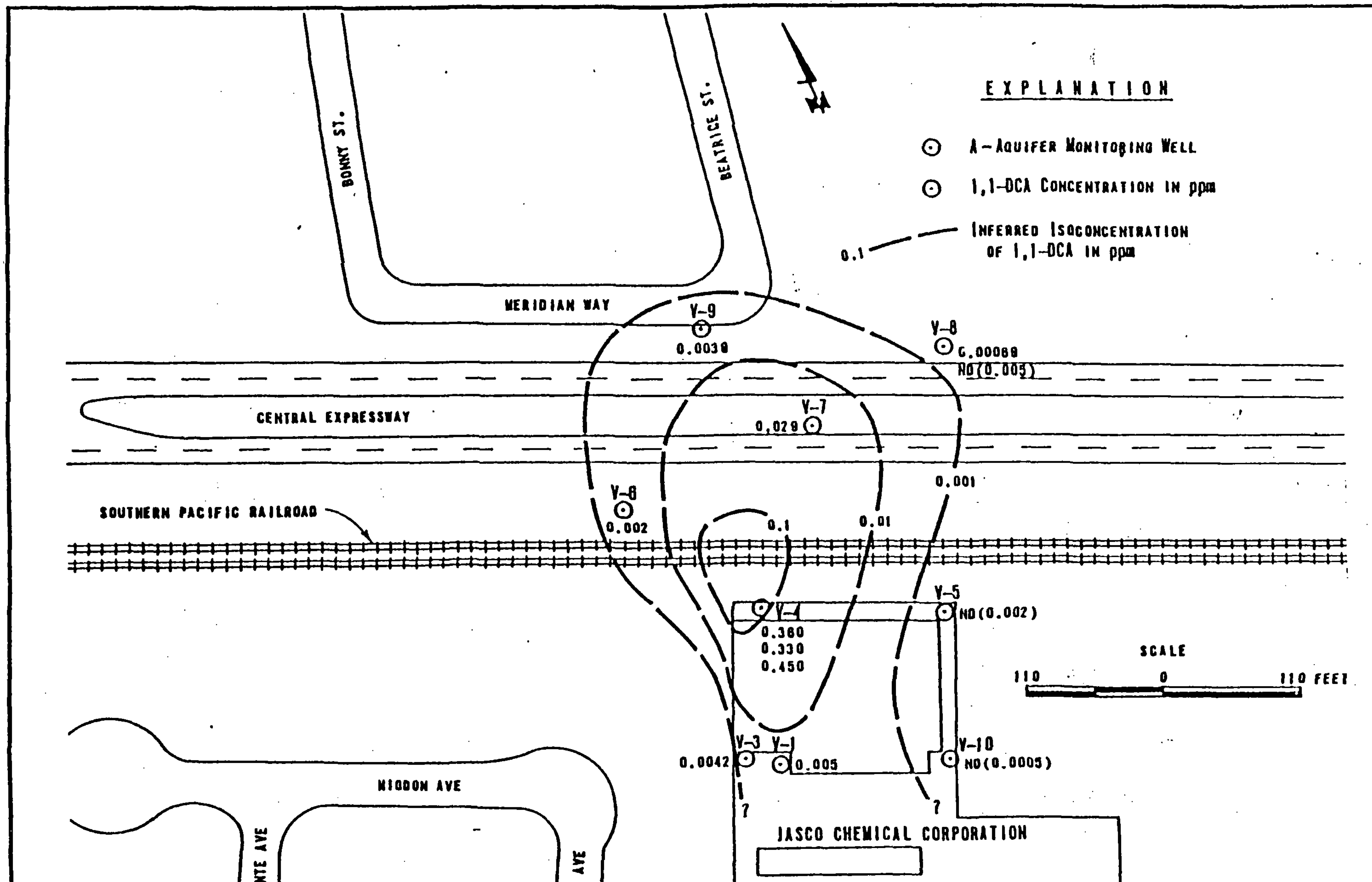
JASCO CHEMICAL CORPORATION
MOUNTAIN VIEW, CALIFORNIA

JACOBS ENGINEERING GROUP INC.

DISTRIBUTION OF 1,1,1-TCA IN A-AQUIFER MONITORING WELLS
March 22-24, 1988

FIGURE A-7

Source: Wahler Assoc.



JASCO CHEMICAL CORPORATION
MOUNTAIN VIEW, CALIFORNIA

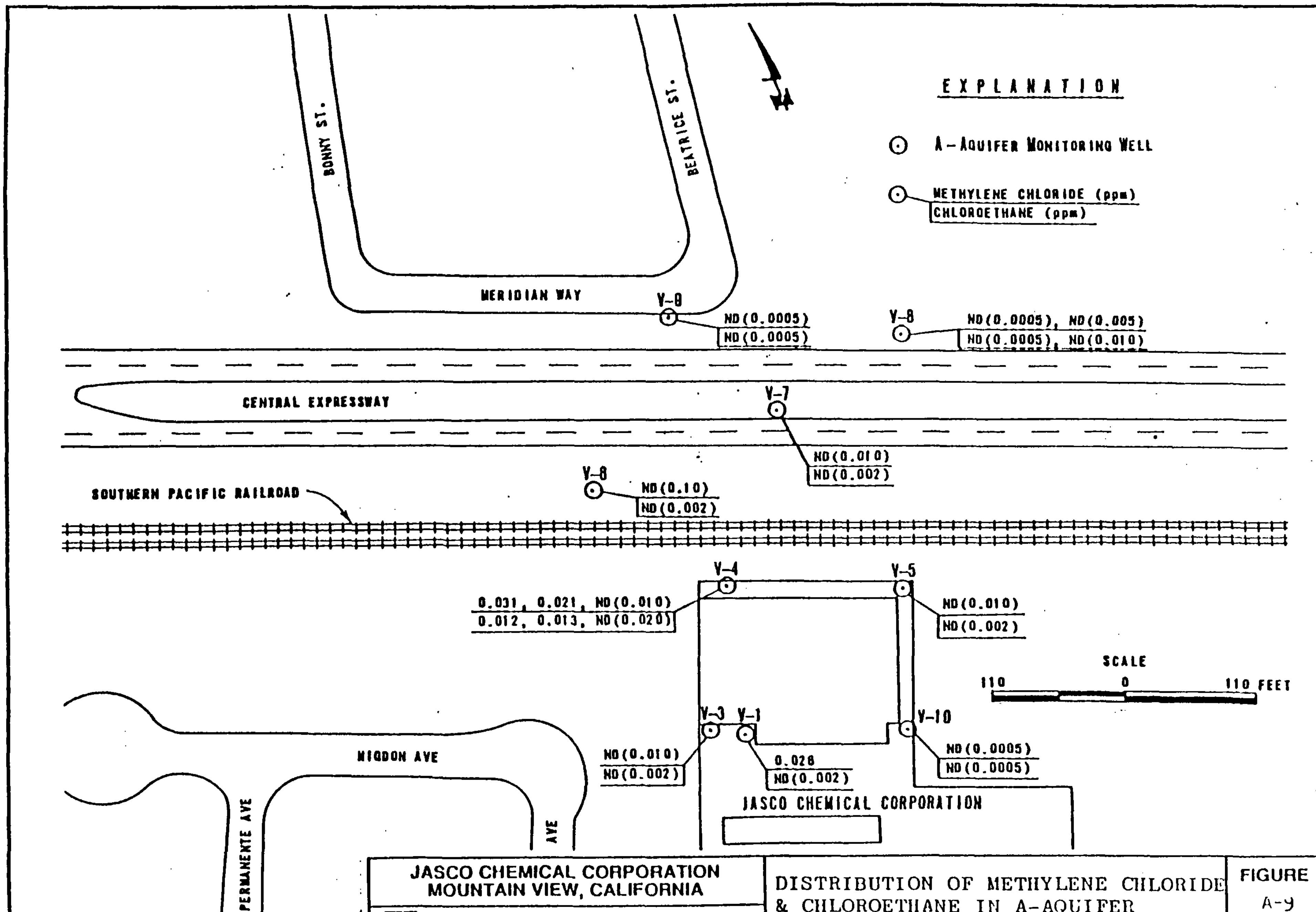
JE JACOBS ENGINEERING GROUP INC.

DISTRIBUTION OF 1,1-DCA IN A-AQUIFER MONITORING WELLS

March 22-24, 1988

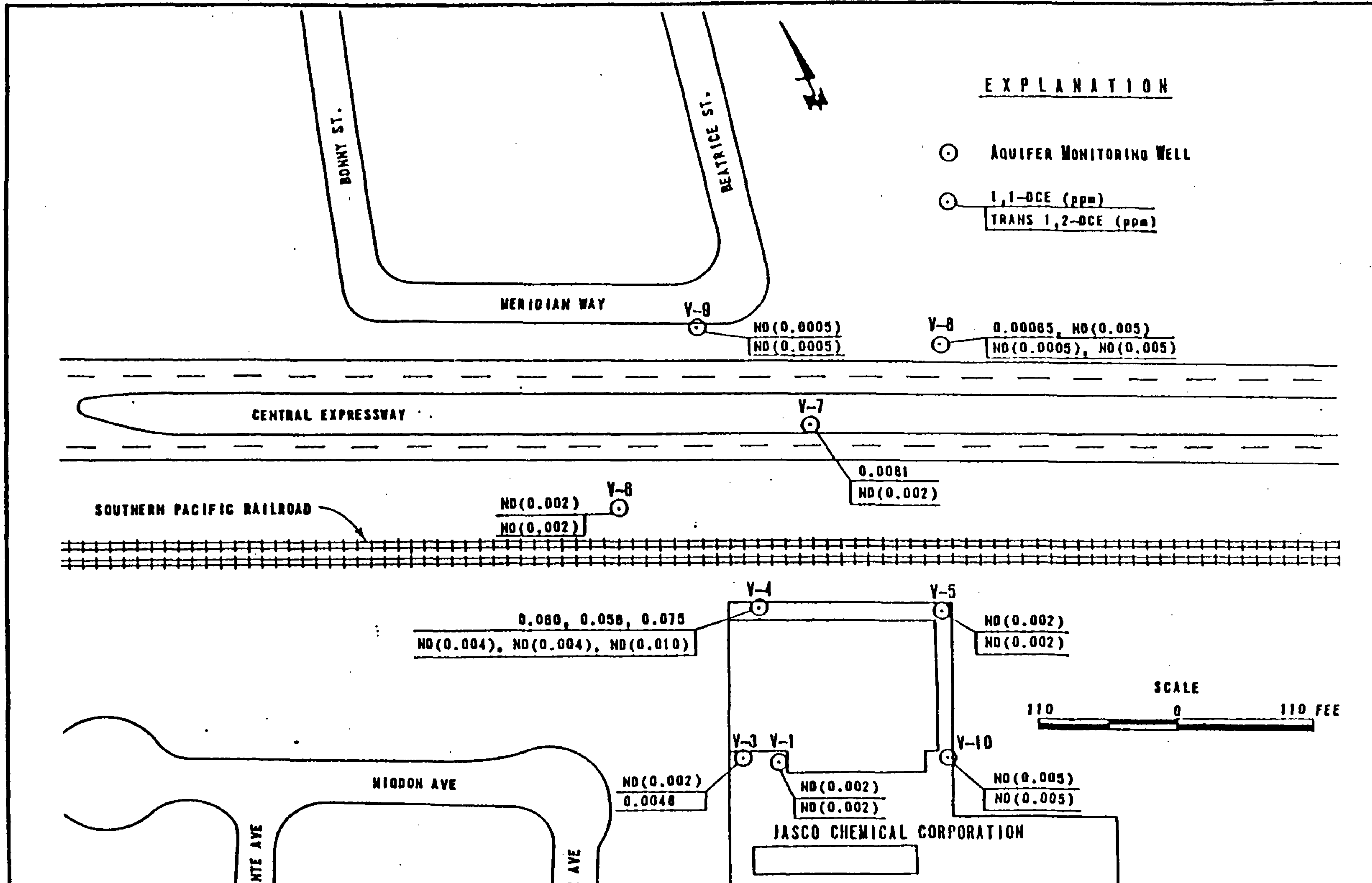
FIGURE A-8

Source: Wahler Assoc.



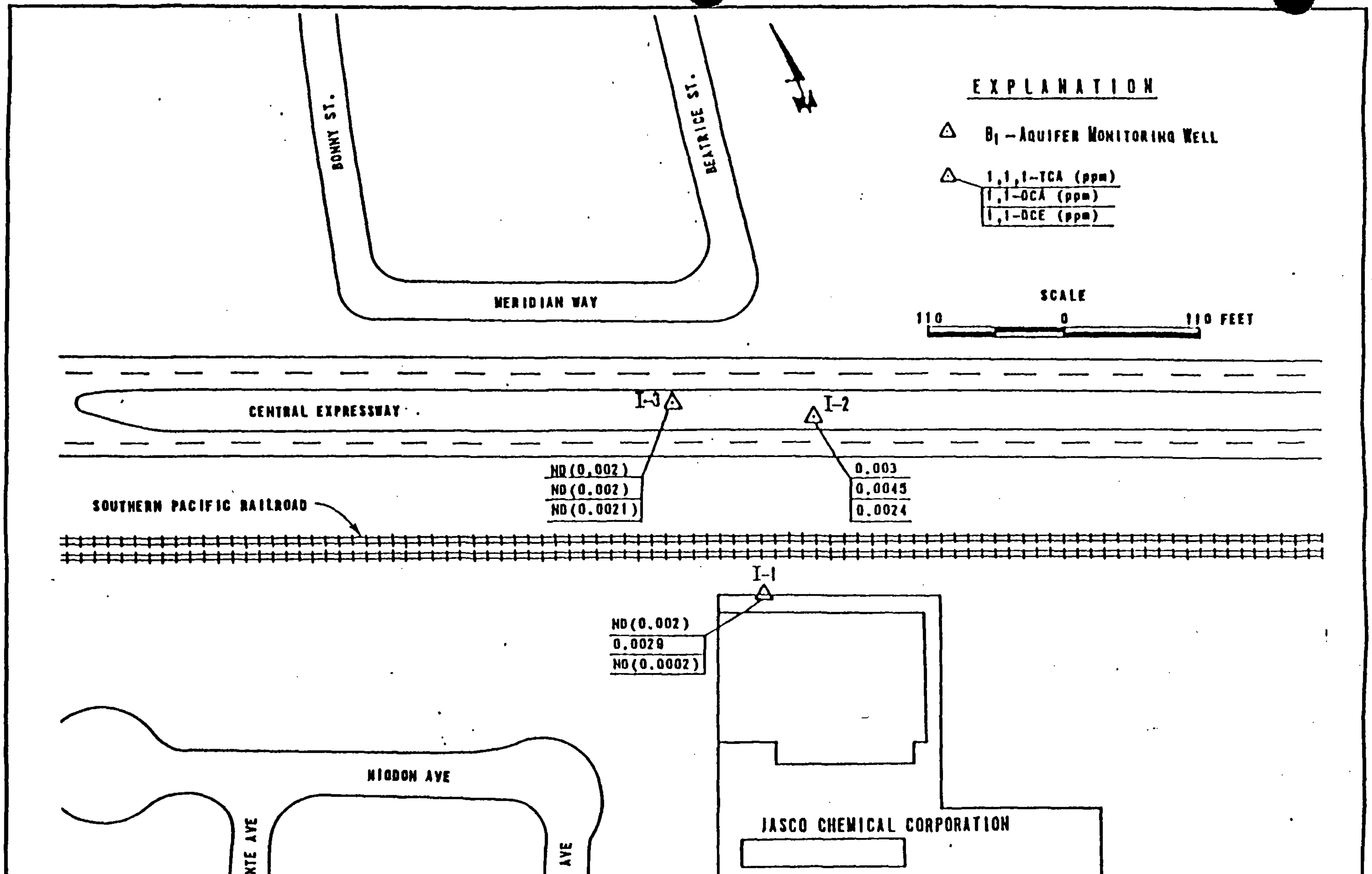
JASCO CHEMICAL CORPORATION MOUNTAIN VIEW, CALIFORNIA JE JACOBS ENGINEERING GROUP INC.	DISTRIBUTION OF METHYLENE CHLORIDE & CHLOROETHANE IN A-AQUIFER MONITORING WELLS-March 22-24, 1988	FIGURE A-9

Source: Wahler Assoc.



JASCO CHEMICAL CORPORATION MOUNTAIN VIEW, CALIFORNIA JE JACOBS ENGINEERING GROUP INC.	DISTRIBUTION OF 1,1-DCE AND TRANS-1,2-DCE IN A-AQUIFER MONITORING WELLS - March 22-24, 1988	FIGURE A-10

Source: Wahler Assoc.



JASCO CHEMICAL CORPORATION
MOUNTAIN VIEW, CALIFORNIA

JACOBS ENGINEERING GROUP INC.

DISTRIBUTION OF CHEMICALS WITHIN B_1-AQUIFER MONITORING WELLS
March 22 -23, 1988

FIGURE A-11

Source: Wahler Assoc.

TABLE A-1: CHEMICAL ANALYSIS RESULTS A-AQUIFER GROUND WATER SAMPLES (ppm)

WELL NAME	METHOD/ LAB	SAMPLING DATE	ACETONE	BENZENE	CHLOROETHANE	1,1-DCA
V-1	?	06-04-84	0.09200	—	—	—
V-1	AN/?	04-04-85	<0.01000	—	—	—
V-1	W/?	11-05-86	—	—	—	—
V-1	S/a	08-27-87	ND	ND	ND	ND
V-1	S/a	09-24-87	ND	ND	ND	0.00570
V-1	S/601/602	01-11-88	0.01400	--	0.00310	0.00400
V-1	S/8240	03-24-88	—	—	ND	0.00520
V-2	A/?	08-27-86	<0.01500	—	—	—
V-2	AN/?	10-06-86	<0.01500	—	—	—
V-2	W/?	11-05-86	—	—	—	—
V-2	S/601	12-17-86	—	—	0.17000	0.39000
V-2	SEL/601	02-20-87	—	—	<0.50000	<0.50000
V-2	S/601	03-02-87	—	—	0.35000	1.20000
V-2	S/601	03-19-87	—	—	<0.25000	0.90000
V-2	S/601	05-05-87	—	—	0.00600	0.54000
V-2	S/624	06-22-87	—	ND	0.14000	0.33000
V-2	AN/601/602+	08-27-87	ND	0.02000	ND	0.63000
V-2	S/a	08-27-87	ND	ND	ND	0.65000
V-2	S/a	09-25-87	0.95000	ND	ND	0.49000
V-2	ANR/601/602+	09-25-87	—	0.00700	0.02600	0.70000
V-2	S/601/602+	01-11-88	1.00000	—	0.15000	0.25000
V-2	DUP S/601/602+	01-11-88	—	—	0.00400	0.36000
V-2	AN/601/8010	01-11-88	—	—	ND	0.58000
V-3	W/?	11-05-86	1.00000	—	—	—
V-3	S/624/625	01-30-87	—	ND	<0.00250	<0.20000
V-3	S/a	08-25-87	ND	ND	ND	0.01500
V-3	S/a	09-25-87	ND	ND	ND	0.02660
V-3	S/601/602+	01-05-88	ND	—	ND	0.02500
V-3	S/624+	03-09-88	—	—	—	0.00620
V-3	AN/624	03-09-88	—	—	—	0.00700
V-3	S/8240/8270	03-22-88	—	ND	ND	0.00420
V-3	S/8240/8270	05-02-88	—	ND	ND	0.00412
V-4	S/601	04-03-87	—	—	0.16000	2.20000
V-4	S/601	05-20-87	—	—	0.01200	1.20000
V-4	S/624	06-22-87	—	ND	0.06500	0.52000
V-4	S/a	08-27-87	ND	ND	ND	0.48000
V-4	S/601/602+	09-25-87	—	ND	0.06300	0.30000
V-4	ANR/601/602+	09-25-87	—	ND	0.05900	1.00000
V-4	S/a	09-25-87	ND	ND	0.23700	0.31000
V-4	S/601/602	01-06-88	0.01500	—	0.02500	0.53000
V-4	DUP S/601/602	01-06-88	—	—	0.04100	0.55000
V-4	ANA/601/8010	01-05-88	—	—	ND	0.97000
V-4	S/8240	03-22-88	—	—	0.01030	0.36000
V-4	S/8240	03-22-88	—	—	0.01300	0.13000

CHEMICAL ANALYSIS RESULTS

TABLE A-1 (Continued)

WELL NAME	METHOD/ LAB	SAMPLING DATE	ACETONE	BENZENE	CHLOROETHANE	1,1-DCA
V-5	A/624	05-05-87	—	—	<0.00500	<0.00470
V-5	S/624	06-22-87	—	ND	ND	ND
V-5	S/a	08-27-87	ND	ND	ND	ND
V-5	S/a	09-24-87	ND	ND	ND	ND
V-5	S/601/602+	01-11-88	ND	—	ND	ND
V-5	S/8240	03-22-88	—	—	ND	ND
V-6	A/624	05-05-87	—	—	<0.00500	<0.00470
V-6	S/624	06-22-87	—	ND	ND	ND
V-6	S/a	08-28-87	ND	ND	ND	ND
V-6	S/a	09-24-87	ND	0.00190	ND	ND
V-6	S/601/602+	01-11-88	ND	—	ND	ND
V-6	S/8240	03-23-88	—	—	ND	ND
V-7	A/624	05-05-87	—	—	<0.00500	0.05500
V-7	S/624	06-22-87	—	ND	ND	0.04900
V-7	S/a	08-28-87	ND	ND	ND	0.02400
V-7	S/a	09-25-87	ND	ND	ND	0.01900
V-7	S/601/602+	01-11-88	ND	—	ND	0.01400
V-7	S/8240	03-23-88	—	—	ND	0.02900
V-8	S/624	03-08-88	0.00300	ND	ND	ND
V-8	S/8010/8020	03-22-88	ND	ND	ND	0.00260
V-8	A/624	03-22-88	ND	ND	ND	ND
V-9	S/624	03-08-88	ND	ND	ND	0.00360
V-9	S/8010/8020	03-22-88	—	—	ND	0.00390
V-10	S/624	03-09-88	ND	ND	ND	ND
V-10	S/8010/8020	03-22-88	—	—	ND	ND

TABLE A-1 (Continued)

WELL NAME	METHOD/ LAB	SAMPLING DATE	1,1-DCE	1,2-DCA	TRANS 1,2-DCE	ETHYLBENZENE
V-1	?	06-04-84	—	—	—	—
V-1	AN/?	04-04-85	—	—	—	—
V-1	W/?	11-05-86	—	—	—	—
V-1	S/a	08-27-87	ND	ND	ND	—
V-1	S/a	09-24-87	0.00053	ND	0.00140	—
V-1	S/601/602	01-11-88	0.00070	ND	0.00150	ND
V-1	S/8240	03-24-88	ND	—	ND	—
V-2	A/?	08-27-86	—	—	—	—
V-2	AN/?	10-06-86	—	—	—	—
V-2	W/?	11-05-86	—	—	—	—
V-2	S/601	12-17-87	<0.00500	—	—	—
V-2	SEL/601	02-23-87	<0.50000	2.50000	—	—
V-2	S/601	03-02-87	0.11000	—	—	—
V-2	S/601	03-19-87	<0.02000	—	—	—
V-2	S/601	05-05-87	0.25100	—	—	—
V-2	S/624	06-22-87	0.02900	ND	0.01300	ND
V-2	AN/601/602+	08-27-87	ND	ND	ND	—
V-2	S/a	08-27-87	ND	ND	ND	—
V-2	S/a	09-25-87	ND	ND	ND	—
V-2	ANR/601/602+	09-25-87	0.07600	ND	ND	—
V-2	S/601/602+	01-11-88	0.02600	0.00650	0.00463	0.01200
V-2	DUP S/601/602+	01-11-88	0.00200	ND	0.00510	0.00760
V-2	AN/601/8010	01-11-88	ND	ND	ND	0.05700
V-3	W/?	11-05-86	—	—	—	—
V-3	S/624/602	01-30-87	<0.00050	—	0.00400	—
V-3	S/a	08-28-87	0.00130	0.0010	0.01200	—
V-3	S/a	09-25-87	0.00076	ND	0.00910	—
V-3	S/601/602+	01-08-88	0.00080	ND	0.00400	ND
V-3	S/624+	03-09-88	—	—	0.00450	—
V-3	AN/624	03-09-88	—	—	ND	—
V-3	S/8240/8270	03-22-88	ND	—	0.00400	ND
V-3	S/8240/8270	05-02-88	ND	—	0.00510	ND
V-4	S/601	04-03-87	0.17000	—	—	—
V-4	S/601	05-22-87	0.14000	—	—	—
V-4	S/624	06-22-87	0.15000	ND	0.00560	ND
V-4	S/a	08-27-87	0.03600	ND	ND	—
V-4	S/601/602+	09-25-87	0.21600	ND	ND	—
V-4	ANR/601/602+	09-25-87	0.22000	0.00600	ND	—
V-4	S/a	09-25-87	0.31400	ND	ND	—
V-4	S/601/602	01-08-88	0.26300	0.24100	ND	ND
V-4	DUP S/601/602	01-08-88	0.07500	0.05200	ND	ND
V-4	ANA/601/8010	01-08-88	0.07700	ND	ND	ND
V-4	S/8240	03-22-88	0.06000	—	ND	—
V-4	S/8240	03-22-88	0.25600	—	ND	—

TABLE A-1 (Continued)

WELL NAME	METHOD/ LAB	SAMPLING DATE	1,1-DCE	1,2-DCA	TRANS 1,2-DCE	ETHYLBENZENE
V-5	A/624	05-05-87	<0.00250	—	—	—
V-5	S/624	06-22-87	ND	ND	ND	ND
V-5	S/a	08-27-87	ND	ND	ND	—
V-5	S/a	09-24-87	ND	ND	ND	—
V-5	S/601/602+	01-11-88	ND	ND	ND	ND
V-5	S/8240	03-22-88	ND	—	ND	—
V-6	A/624	05-05-87	<0.00250	—	—	—
V-6	S/624	06-22-87	ND	ND	ND	ND
V-6	S/a	08-28-87	ND	ND	ND	—
V-6	S/a	09-24-87	ND	ND	ND	—
V-6	S/601/602+	01-11-88	ND	ND	ND	ND
V-6	S/8240	03-23-88	ND	—	ND	—
V-7	A/624	05-05-87	0.38770	—	—	—
V-7	S/624	06-22-87	ND	ND	ND	ND
V-7	S/a	08-19-87	0.00190	ND	ND	—
V-7	S/a	09-25-87	0.00240	ND	ND	—
V-7	S/601/602+	01-11-88	0.00350	ND	ND	ND
V-7	S/8240	03-23-88	0.06810	—	ND	—
V-8	S/624	03-08-88	ND	ND	ND	ND
V-8	S/5010/8020	03-22-88	0.00065	ND	ND	ND
V-8	A/624	03-22-88	ND	ND	ND	ND
V-9	S/624	03-08-88	ND	ND	ND	ND
V-9	S/5010/8020	03-22-88	ND	ND	ND	ND
V-10	S/624	03-09-88	ND	ND	ND	—
V-10	S/5010/8020	03-22-88	ND	ND	ND	—

TABLE A-1 (Continued)

WELL NAME	METHOD/ LAB	SAMPLING DATE	METHYLENE CHLORIDE	MEK	PCP	TETRACHLORO-ETHENE
V-1	?	06-04-84	<0.00500	0.02400	0.00020	—
V-1	AN/?	04-04-85	0.01000	—	0.00120	—
V-1	W/?	11-05-86	0.01500	—	—	—
V-1	S/a	08-27-87	ND	ND	—	—
V-1	S/a	09-24-87	ND	ND	—	—
V-1	S/601/602	01-11-88	0.00140	ND	ND	—
V-1	S/8240	03-24-88	0.02500	—	—	—
V-2	W/?	05-27-86	3.20000	<0.01500	0.00150	—
V-2	AN/?	10-06-86	3.20000	<0.01500	0.00150	<0.00500
V-2	W/?	11-05-86	142.00000	—	—	—
V-2	S/601	12-17-87	33.00000	—	—	0.00600
V-2	SEL/601	02-20-87	56.00000	—	—	—
V-2	S/601	03-02-87	1.60000	—	—	—
V-2	S/601	03-19-87	2.40000	—	—	—
V-2	S/601	05-05-87	0.70000	—	—	—
V-2	S/624	06-22-87	0.54000	—	—	ND
V-2	AN/601/602+	06-27-87	1.70000	ND	—	—
V-2	S/a	08-27-87	0.27000	ND	—	—
V-2	S/a	09-25-87	0.22000	ND	—	—
V-2	ANR/601/602+	09-25-87	4.60000	0.02700	—	—
V-2	S/601/602+	01-11-88	6.60000	0.01400	—	0.00600
V-2	DUP S/601/602+	01-11-88	5.30000	0.00210	—	ND
V-2	AN/601/8010	01-11-88	0.00000	0.15000	—	ND
V-3	W/?	11-05-86	0.00760	<1.00000	0.05000	—
V-3	S/624/602	01-30-87	<0.00050	—	—	—
V-3	S/a	08-29-87	0.00400	ND	—	—
V-3	S/a	09-25-87	0.01200	ND	—	—
V-3	S/601/602+	01-09-88	0.00250	ND	—	ND
V-3	S/624+	03-09-88	—	—	—	—
V-3	AN/624	03-09-88	—	—	—	—
V-3	S/8240/8270	03-22-88	ND	—	ND	ND
V-3	S/8240/8270	05-02-88	ND	—	ND	ND
V-4	S/601	04-23-87	1.40000	—	—	—
V-4	S/601	05-20-87	0.49000	—	—	—
V-4	S/624	06-22-87	0.11000	—	—	ND
V-4	S/a	08-27-87	ND	ND	—	—
V-4	S/601/602+	09-25-87	ND	ND	—	—
V-4	ANR/601/602+	09-25-87	0.00300	ND	—	—
V-4	S/a	09-25-87	ND	ND	—	—
V-4	S/601/602	01-06-88	0.21000	ND	—	ND
V-4	DUP S/601/602	01-06-88	0.22000	ND	—	ND
V-4	ANA/601/8010	01-06-88	0.36000	ND	—	ND
V-4	S/8240	03-22-88	0.03100	—	—	—
V-4	S/8240	03-23-88	0.02100	—	—	—

TABLE A-1 (Continued)

WELL NAME	METHOD/ LAB	SAMPLING DATE	METHYLENE CHLORIDE	MEK	PCP	TETRACHLORO-ETHENE
V-5	A/624	05-05-87	<0.00250	—	--	—
V-5	S/624	06-22-87	ND	—	--	ND
V-5	S/a	08-27-87	ND	ND	--	—
V-5	S/a	09-24-87	ND	ND	—	--
V-5	S/601/602+	01-11-88	ND	ND	--	ND
V-5	S/8240	03-23-88	ND	—	--	—
V-6	A/624	05-05-87	<0.00250	—	--	--
V-6	S/624	06-22-87	ND	—	—	ND
V-6	S/a	08-25-87	ND	ND	--	—
V-6	S/a	09-24-87	ND	ND	--	—
V-6	S/601/602+	01-11-88	ND	ND	--	ND
V-6	S/8240	03-23-88	ND	—	—	—
V-7	A/624	05-05-87	<0.00250	—	—	—
V-7	S/624	06-22-87	ND	—	ND	—
V-7	S/a	08-28-87	ND	ND	—	—
V-7	S/a	09-25-87	ND	ND	—	—
V-7	S/601/602+	01-11-88	ND	ND	—	ND
V-7	S/8240	03-23-88	ND	—	—	—
V-8	S/624	03-08-88	ND	—	ND	ND
V-8	S/8010/8020	03-22-88	ND	ND	—	ND
V-8	A/624	03-22-88	ND	ND	—	ND
V-9	S/624	03-08-88	ND	—	—	ND
V-9	S/8010/8020	03-22-88	ND	—	—	ND
V-10	S/624	03-09-88	ND	ND	ND	ND
V-10	S/8010/8020	03-22-88	ND	—	—	ND

TABLE A-1 (Continued)

WELL NAME	METHOD/ LAB	SAMPLING DATE	TOLUENE	1,1,1-TCA	TCE	VINYL CHLORIDE
V-1	?	06-04-84	—	0.00922	—	—
V-1	AN/?	04-04-85	—	—	—	—
V-1	W/?	11-05-86	—	—	—	—
V-1	S/a	08-17-87	ND	ND	ND	ND
V-1	S/a	09-24-87	ND	ND	ND	ND
V-1	S/601/602	01-11-88	ND	ND	ND	ND
V-1	S/8240	03-24-88	—	ND	—	—
V-2	A/?	08-27-86	—	0.02600	—	—
V-2	AN/?	10-06-86	—	<0.02000	—	—
V-2	W/?	11-05-86	—	—	—	—
V-2	S/601	12-17-87	—	0.54000	0.01900	<0.00500
V-2	SEL/601	02-18-87	—	2.04000	<0.50000	<0.50000
V-2	S/601	03-02-87	—	0.61000	<0.25000	<0.05000
V-2	S/601	03-19-87	—	0.51000	<0.05000	<0.05000
V-2	S/601	05-05-87	—	0.41000	0.01300	0.00510
V-2	S/624	06-22-87	0.01500	0.37700	0.00220	0.00920
V-2	AN/601/602+	08-27-87	0.25000	0.20000	ND	ND
V-2	S/a	08-27-87	ND	0.27000	ND	ND
V-2	S/a	09-25-87	ND	0.53000	ND	ND
V-2	ANR/601/602+	09-25-87	0.29000	0.50000	ND	ND
V-2	S/601/602+	01-11-88	0.03500	0.20000	0.01200	0.00720
V-2	DUP S/601/602+	01-11-88	0.02100	0.24000	0.00990	0.00410
V-2	AN/601/8010	01-11-88	0.36000	0.17000	ND	ND
V-3	W/?	11-05-86	—	<0.00050	—	—
V-3	S/624/602	01-30-87	ND	<0.00050	<0.00050	<0.00050
V-3	S/a	05-28-87	ND	0.00100	ND	ND
V-3	S/a	09-25-87	ND	0.00110	ND	0.00065
V-3	S/601/602+	01-08-88	ND	0.00060	ND	0.00060
V-3	S/624+	03-09-88	—	—	—	—
V-3	AN/624	03-09-88	—	—	—	—
V-3	S/8240/8270	03-22-88	ND	—	ND	ND
V-3	S/8240/8270	05-02-88	ND	—	ND	ND
V-4	S/601	04-03-87	—	1.30000	<0.01000	0.01100
V-4	S/601	05-28-87	—	0.39000	<0.00500	<0.00500
V-4	S/624	06-22-87	0.00300	0.17000	ND	0.01600
V-4	S/a	08-27-87	ND	0.26000	ND	ND
V-4	S/601/602+	09-25-87	ND	0.05100	ND	ND
V-4	ANR/601/602+	09-25-87	0.21700	0.22000	ND	ND
V-4	S/a	09-25-87	ND	0.23000	ND	ND
V-4	S/601/602	01-06-88	0.01400	0.25000	0.00050	0.01000
V-4	DUP S/601/602	01-06-88	0.01000	0.25000	ND	0.01500
V-4	ANA/601/8010	01-22-88	ND	0.54000	ND	ND
V-4	S/8240	03-22-88	—	0.14000	—	—
V-4	S/8240	03-22-88	—	0.12000	—	—

TABLE A-1 (Continued)

WELL NAME	METHOD/ LAB	SAMPLING DATE	TOLUENE	1,1,1-TCA	TCE	VINYL CHLORIDE
V-5	A/624	05-05-87	—	<0.00020	<0.00190	<0.02500
V-5	S/624	06-22-87	ND	ND	ND	ND
V-5	S/a	08-27-87	ND	ND	ND	ND
V-5	S/a	09-24-87	ND	ND	ND	ND
V-5	S/601/602+	01-11-88	ND	ND	ND	ND
V-5	S/8240	03-23-88	—	ND	—	—
V-6	A/624	05-05-87	—	<0.00020	<0.00190	<0.02500
V-6	S/624	06-22-87	ND	ND	ND	ND
V-6	S/a	08-28-87	ND	0.00230	ND	ND
V-6	S/a	09-24-87	ND	0.00450	ND	ND
V-6	S/601/602+	01-11-88	ND	0.00250	ND	ND
V-6	S/8240	03-23-88	—	ND	—	—
V-7	A/624	05-05-87	—	0.06400	<0.00190	<0.02500
V-7	S/624	06-22-87	ND	0.02300	ND	ND
V-7	S/a	08-28-87	ND	0.01600	ND	ND
V-7	S/a	09-25-87	ND	0.02300	ND	ND
V-7	S/601/602+	01-11-88	ND	0.01200	ND	0.00120
V-7	S/8240	03-23-88	—	0.01500	ND	—
V-8	S/624	03-08-88	ND	0.00350	ND	ND
V-8	S/8010/8020	03-22-88	ND	0.00370	ND	ND
V-8	A/624	03-22-88	ND	0.00700	ND	ND
V-9	S/624	03-08-88	ND	ND	ND	ND
V-9	S/8010/8020	03-22-88	ND	0.00200	ND	ND
V-10	S/624	03-09-88	ND	ND	ND	ND
V-10	S/8010/8020	03-22-88	ND	0.00096	ND	ND

TABLE A-1 (Continued)

WELL NAME	METHOD/ LAB	SAMPLING DATE	XYLENE
V-1	?	06-04-84	--
V-1	AN/?	04-04-85	--
V-1	W/?	11-05-86	--
V-1	S/a	08-27-87	ND
V-1	S/a	09-24-87	ND
V-1	S/601/602	01-11-88	ND
V-1	S/8240	03-24-88	--
V-2	A/?	08-27-86	--
V-2	AN/?	10-06-86	--
V-2	W/?	11-05-86	--
V-2	S/601	12-17-87	--
V-2	SEL/601	02-28-87	--
V-2	S/601	03-02-87	--
V-2	S/601	03-19-87	--
V-2	S/601	05-05-87	--
V-2	S/624	06-22-87	--
V-2	AN/601/602+	08-27-87	0.25000
V-2	S/a	08-27-87	ND
V-2	S/a	09-25-87	0.02600
V-2	ANR/601/602+	09-25-87	0.04400
V-2	S/601/602+	01-11-88	0.22900
V-2	DUP S/601/602+	01-11-88	0.26200
V-2	AN/601/8010	01-11-88	0.03500
V-3	W/?	11-05-86	--
V-3	S/624/602	01-30-87	ND
V-3	S/a	08-28-87	0.20600
V-3	S/a	09-25-87	ND
V-3	S/601/602+	01-08-88	ND
V-3	S/624+	03-09-88	--
V-3	AN/624	03-09-88	--
V-3	S/8240/8270	03-22-88	--
V-3	S/8240/8270	05-02-88	--
V-4	S/601	04-03-87	--
V-4	S/601	05-28-87	--
V-4	S/624	06-22-87	--
V-4	S/a	08-27-87	ND
V-4	S/601/602+	09-25-87	ND
V-4	ANR/601/602+	09-25-87	ND
V-4	S/a	09-25-87	ND
V-4	S/601/602	01-08-88	ND
V-4	DUP S/601/602	01-08-88	ND
V-4	ANA/601/8010	01-08-88	ND
V-4	S/8240	03-22-88	--
V-4	S/8240	03-22-88	--

TABLE A-1 (Continued)

WELL NAME	METHOD/ LAB	SAMPLING DATE	XYLENE
V-5	A/624	05-25-87	—
V-5	S/624	06-22-87	--
V-5	S/a	08-27-87	ND
V-5	S/a	09-24-87	ND
V-5	S/601/602+	01-11-88	ND
V-5	S/8240	03-23-88	—
V-6	A/624	05-25-87	—
V-6	S/624	06-22-87	—
V-6	S/a	08-28-87	ND
V-6	S/a	09-24-87	ND
V-6	S/601/602+	01-11-88	ND
V-6	S/8240	03-23-88	--
V-7	A/624	05-25-87	—
V-7	S/624	06-22-87	—
V-7	S/a	08-28-87	ND
V-7	S/a	09-25-87	ND
V-7	S/601/602+	01-11-88	ND
V-7	S/8240	03-23-88	—
V-8	S/624	03-08-89	—
V-8	S/8010/8020	03-22-89	—
V-8	A/624	03-22-89	—
V-9	S/624	03-08-89	--
V-9	S/8010/8020	03-22-89	—
V-10	S/624	03-09-89	—
V-10	S/8010/8020	03-22-89	ND

S = Sequoia Analytical Laboratory
SEL = Scientific Environmental Laboratories
A = Anatec
ANR = Anresco
ANA = Anametrix
W = Wesco Laboratories
ND = Compound Not Detected
— = Compound Not Analyzed

601/602+ = EPA Methods 601 and 602, plus analysis for MEK and Xy
a = Includes 601/602+, EPA Method 624

TABLE A-2: CHEMICAL ANALYSIS RESULTS B_1-AQUIFER GROUND WATER SAMPLES (ppm)

WELL NAME	METHOD/ LAB	SAMPLING DATE	ACETONE	BENZENE	CHLOROETHANE	1,1-DCA
I-1	A/624	05-15-87	--	ND	ND	0.01100
I-1	S/624	06-03-87	--	ND	ND	0.00390
I-1	S/624	06-22-87	--	ND	ND	ND
I-1	S/a	08-27-87	ND	ND	ND	0.00230
I-1	S/a	09-25-87	ND	ND	ND	0.00380
I-1	S/601/602+	01-11-88	ND	--	ND	0.00120
I-1	S/8240	03-23-88	--	--	ND	0.00290
I-2	S/624 (DS)	08-25-87	ND	ND	ND	0.01400
I-2	S/a	09-24-87	ND	ND	ND	ND
I-2	S/601/602+	01-11-88	ND	--	ND	ND
I-2	S/8240	03-23-88	--	--	ND	0.00450
I-3	S/624 (DS)	08-28-87	ND	ND	ND	ND
I-3	S/a	09-24-87	ND	ND	ND	ND
I-3	S/601/602+	01-11-88	ND	--	ND	ND
I-3	S/8240	03-23-88	--	--	ND	ND

WELL NAME	METHOD/ LAB	SAMPLING DATE	1,1-DCE	1,2-DCA	TRANS 1,2-DCE	ETHYLBENZENE
I-1	A/624	05-15-87	ND	ND	ND	ND
I-1	S/624	06-03-87	ND	ND	ND	ND
I-1	S/624	06-22-87	ND	ND	ND	ND
I-1	S/a	08-27-87	ND	ND	ND	--
I-1	S/a	09-25-87	ND	ND	ND	--
I-1	S/601/602+	01-11-88	ND	ND	ND	ND
I-1	S/8240	03-23-88	ND	--	ND	--
I-2	S/624 (DS)	08-25-87	0.00710	ND	ND	--
I-2	S/a	09-24-87	ND	ND	ND	--
I-2	S/601/602+	01-11-88	ND	ND	ND	ND
I-2	S/8240	03-23-88	0.00240	--	ND	--
I-3	S/624 (DS)	08-28-87	ND	ND	ND	--
I-3	S/a	09-24-87	ND	ND	ND	--
I-3	S/601/602+	01-11-88	ND	ND	ND	ND
I-3	S/8240	03-23-88	ND	--	ND	--

TABLE A-2 (Continued)

WELL NAME	METHOD/ LAB	SAMPLING DATE	METHYLENE CHLORIDE	MEK	PCP	TETRACHLORO- ETHENE	TOLUENE
I-1	A/624	05-15-87	ND	ND	--	ND	ND
I-1	S/624	06-03-87	ND	--	--	ND	ND
I-1	S/624	06-22-87	0.03200	--	--	ND	ND
I-1	S/a	08-27-87	ND	ND	--	--	ND
I-1	S/a	09-25-87	ND	ND	--	--	ND
I-1	S/601/602+	01-11-88	ND	ND	--	ND	ND
I-1	S/8240	03-23-88	ND	--	--	--	--
I-2	S/624 (OS)	08-28-87	ND	ND	--	--	ND
I-2	S/a	09-24-87	ND	ND	--	--	ND
I-2	S/601/602+	01-11-88	ND	ND	--	ND	ND
I-2	S/8240	03-23-88	ND	--	--	--	--
I-3	S/624 (OS)	08-28-87	ND	ND	--	--	ND
I-3	S/a	09-24-87	ND	ND	--	--	ND
I-3	S/601/602+	01-11-88	ND	ND	--	ND	ND
I-3	S/8240	03-23-88	ND	--	--	--	--

WELL NAME	METHOD/ LAB	SAMPLING DATE	1,1,1-TCA	TCE	VINYL CHLORIDE	XYLENE
I-1	A/624	05-15-87	ND	ND	ND	ND
I-1	S/624	06-03-87	ND	ND	ND	--
I-1	S/624	06-22-87	ND	ND	ND	--
I-1	S/a	08-27-87	0.00190	ND	ND	ND
I-1	S/a	09-25-87	0.00280	ND	ND	ND
I-1	S/601/602+	01-11-88	0.00210	ND	ND	ND
I-1	S/8240	03-23-88	ND	--	--	--
I-2	S/624 (OS)	08-28-87	0.06660	ND	ND	ND
I-2	S/a	09-24-87	ND	ND	ND	ND
I-2	S/601/602+	01-11-88	ND	ND	ND	ND
I-2	S/8240	03-23-88	0.00320	--	--	--
I-3	S/624 (OS)	08-28-87	ND	ND	ND	ND
I-3	S/a	09-24-87	ND	ND	ND	ND
I-3	S/601/602+	01-11-88	ND	ND	ND	ND
I-3	S/8240	03-23-88	ND	--	--	--

S = Sequoia Analytical Laboratory
SEL = Scientific Environmental Laboratories
A = Anatec
AN = Anresco Inc.
ANA = Anametrix
W = Wesco Laboratories
ND = Compound Not Detected
-- = Compound Not Analyzed

601/602+ = EPA Methods 601 and 602, plus analysis for MEK and Xylenes
a = Includes 601/602+, EPA Method 604

TABLE A-3: CHEMICAL ANALYSIS RESULTS SURFACE WATER SAMPLES (mg/l)

SAMPLE ID	LOCATION	METHOD/LAB	SAMPLING DATE	ACETONE	BENZENE	CHLOROETHANE	1,1-DCA	1,1-DCE
A-1	COLLECTION SUMP	S/601/602	08-26-87	ND	ND	ND	0.00510	ND
S-7	PONDED WATER FROM DRAINAGE SWALE	S/601/602	10-12-87	0.27000	ND	ND	0.05500	ND
S-7A	SAME AS S-7 ABOVE	S/601/602	01-04-88	ND	ND	ND	0.00990	ND
1-AP	ROOF DOWNSPOUT OUTFLOW	S/8010/8020	04-19-88	--	ND	ND	ND	ND
2-AP	DISCHARGE PIPE	S/8010/8020	04-19-88	--	ND	ND	0.00530	ND
3-AP	10' W. OF DISCHG. PIPE	S/8010/8020	04-19-88	--	ND	ND	0.00390	ND
4-AP	PONDED WATER DRAINAGE SWALE	S/8010/8020	04-19-88	--	ND	ND	0.00600	ND
5-AP	SAME AS 4-AP ABOVE	S/8010/8020	04-19-88	--	ND	ND	0.00730	ND
6-AP	SAME AS 4-AP ABOVE	S/8010/8020	04-19-88	--	ND	ND	0.00430	ND
7-AP	COLLECTION SUMP	S/8010/8020	04-19-88	--	ND	ND	ND	ND

TABLE A-3 (Continued)

SAMPLE ID	LOCATION	METHOD/ LAB	SAMPLING DATE	1,2-DCA	TRANS 1,2-DCE	ETHYLBENZENE	METHYLENE CHLORIDE	[illegible]E
W-1	COLLECTION SUMP	S/8010/8020	08-06-87	ND	ND	ND	ND	ND
S-3	PONDED WATER FROM DRAINAGE SWALE	S/8010/8020	12-23-87	ND	ND	ND	1.70000	ND
S-3A	SAME AS S-3 ABOVE	S/8010/8020	01-04-88	ND	ND	ND	0.02500	ND
1-AP	ROOF DOWNSPOUT OUTFLOW	S/8010/8020	04-19-88	ND	ND	ND	0.01400	ND
2-AP	DISCHARGE PIPE	S 8010/8020	04-19-88	ND	ND	ND	0.07000	ND
3-AP	10' W. OF DISCHG. PIPE	S/8010/8020	04-19-88	ND	ND	ND	0.05100	ND
4-AP	PONDED WATER DRAINAGE SWALE	S/8010/8020	04-19-88	ND	ND	ND	0.02500	ND
5-AP	SAME AS 4-AP ABOVE	S/8010/8020	04-19-88	ND	ND	ND	0.02600	ND
6-AP	SAME AS 4-AP ABOVE	S/8010/8020	04-19-88	ND	ND	ND	0.22100	ND
7-AP	COLLECTION SUMP	S/8010/8020	04-19-88	ND	ND	ND	ND	ND

TABLE A-3 (Continued)

SAMPLE ID	LOCATION	METHOD/ LAB	SAMPLING DATE	PCP	TETRACHLORO- ETHENE	TOLUENE	1,1,1-TCA	TCE
W-1	COLLECTION SUMP	S/601/602	09-0[illegible]-87	ND	ND	ND	[illegible]	ND
S-T	PONDED WATER FROM DRAINAGE SWALE	S/601/602	10-[illegible]-87	[illegible]	ND	ND	[illegible]	ND
S-TA	SAME AS S-T ABOVE	S/601/602	01-04-88	ND	ND	ND	[illegible]	ND
1-AP	ROOF DOWNSPOUT OUTFLOW	S/8010/8020	04-19-88	--	ND	ND	ND	ND
2-AP	DISCHARGE PIPE	S/8010/8020	04-19-88	--	ND	ND	0.04700	ND
3-AP	10' W. OF DISCHG. PIPE	S/8010/8020	04-19-88	--	ND	ND	0.04700	ND
4-AP	PONDED WATER DRAINAGE SWALE	S/8010/8020	04-19-88	--	ND	ND	0.02400	ND
5-AP	SAME AS 4-AP ABOVE	S/8010/8020	04-19-88	--	ND	ND	0.02400	ND
6-AP	SAME AS 4-AP ABOVE	S/8010/8020	04-19-88	--	ND	ND	0.04200	ND
7-AP	COLLECTION SUMP	S/8010/8020	04-19-88	--	ND	ND	ND	ND

TABLE A-3 (Continued)

SAMPLE ID	LOCATION	METHOD LAB	SAMPLING DATE	VINYL CHLORIDE	XYLENE
[illegible]	COLLECTION SUMP	S/601/602	02-26-87	ND	ND
S-7	PONDED WATER FROM DRAINAGE SWALE	S 601/602	10-23-87	ND	0.02950
S-7A	SAME AS S-7 ABOVE	S/601/602	01-04-88	ND	ND
1-AP	ROOF DOWNSPOUT OUTFLOW	S/8010/8020	04-19-88	ND	ND
2-AP	DISCHARGE PIPE	S/8010/8020	04-19-88	ND	ND
3-AP	10 W. OF DISCHG. PIPE	S/8010/8020	04-19-88	ND	ND
4-AP	PONDED WATER DRAINAGE SWALE	S/8010/8020	04-19-88	ND	ND
5-AP	SAME AS 4-AP ABOVE	S/8010/8020	04-19-88	ND	ND
6-AP	SAME AS 4-AP ABOVE	S/8010/8020	04-19-88	ND	ND
7-AP	COLLECTION SUMP	S/8010/8020	04-19-88	ND	ND

S = Sequoia Analytical Laboratory
SEL = Scientific Environmental Laboratories
A = Anatec
AN = Anresco Inc.
ANA = Anametrix
W = Wesco Laboratories
ND = Compound Not Detected
-- = Compound Not Analyzed

601/602+ = EPA Methods 601 and 602, plus analysis for MEK and Xylenes
a = Includes 601/602+, EPA Method 604

TABLE A-4: CHEMICAL ANALYSIS RESULTS SOIL SAMPLES (mg/kg)

SAMPLE ID	METHOD/ LAB	SAMPLING DATE	ACETONE	BENZENE	CHLOROETHANE	1,1-DCA	1,1-DCE
SC, 0-15'(V-2)	A/?	08-27-86	<0.10000	—	--	—	--
SC, 20-35'(V-2)	A/?	08-27-86	<0.10000	--	--	—	--
SC, 5.10' (V-3)	W/?	11-25-86	1.00000	—	--	—	--
SC, 13.15'(V-3)	W/?	11-25-86	<1.00000	—	--	--	--
SC, 30'(V-3)	W/?	11-05-86	1.00000	—	--	--	--
S4 (V-4) 14 - 15.5'	S/8010	04-02-87	—	—	<0.25000	<0.25000	<0.25000
S5 (V-4) 20 - 21.5'	S/8010	04-02-87	--	—	<0.25000	0.33000	<0.25000
S9 (V-4) 38.5 - 40'	S/8010	04-02-87	—	—	<0.25000	<0.25000	<0.25000
DRAINAGE SWALE BORINGS							
B-1,R-2	S/8010	06-18-87	—	ND	—	ND	ND
B-1,R-6	S/8010	06-18-87	—	ND	—	ND	ND
B-2,R-1	S/8010	06-18-87	ND	ND	—	ND	ND
B-2,R-2	S/8010	06-18-87	—	ND	—	ND	ND
B-2,R-4	S/8010	06-18-87	—	ND	—	ND	ND
B-2,R-6	S/8010	06-18-87	ND	ND	—	ND	ND
B-3,R-1	S/8010	06-18-87	ND	ND	—	ND	ND
B-3,R-4	S/8010	06-18-87	—	ND	—	ND	ND
B-3,R-6	S/8010	06-18-87	ND	ND	—	ND	ND
B-4,R-1	S/8010	06-18-87	ND	ND	—	ND	ND
B-4,R-3	S/8010	06-18-87	—	ND	—	ND	ND
B-4,R-4	S/8010	06-18-87	—	ND	—	ND	ND
B-4,R-5	S/8010	06-18-87	—	ND	—	ND	ND
B-4,R-6	S/8010	06-18-87	ND	ND	—	ND	ND
B-5,R-1	S/8010	06-18-87	—	ND	—	ND	ND
B-5,R-3	S/8010	06-18-87	ND	ND	—	ND	ND
B-5,R-4	S/8010	06-18-87	ND	ND	—	ND	ND
B-5,R-5	S/8010	06-18-87	—	ND	—	ND	ND
B-5,R-6	S/8010	06-18-87	ND	0.14000	—	ND	ND
B-6,R-1	S/8010	06-18-87	—	ND	—	ND	ND
B-6,R-3	S/8010	06-18-87	ND	ND	—	ND	ND
B-6,4-4	S/8010	06-18-87	ND	ND	—	ND	ND
B-6,R-5	S/8010	06-18-87	—	ND	—	ND	ND
B-6,R-6	S/8010	06-18-87	ND	ND	—	ND	ND
B-7,R-1	S/8010	06-18-87	—	ND	—	ND	ND
B-7,R-2	S/8010	06-18-87	—	ND	—	ND	ND
B-7,R-3	S/8010	06-18-87	ND	ND	—	ND	ND
B-7,R-4	S/8010	06-18-87	ND	ND	—	ND	ND
B-7,R-5	S/8010	06-18-87	—	ND	—	ND	ND
B-7,R-6	S/8010	06-18-87	ND	ND	—	ND	ND
B-8,R-2	S/8010	06-18-87	270.00000	ND	—	27.00000	13.00000
B-8,R-3	S/8010	06-18-87	—	—	—	0.05400	ND
B-8,R-4	S/8010	06-18-87	15.00000	—	—	0.75000	ND
B-8,R-5	S/8010	06-18-87	--	—	—	0.20000	ND
B-8,R-6	S/8010	06-18-87	10.00000	--	—	0.73000	ND

TABLE A-4 (Continued)

SAMPLE ID	METHOD/ LAB	SAMPLING DATE	1,2-DCA	TRANS 1,2-DCE	ETHYLBENZENE	METHYLENE CHLORIDE	MEK
SD, 0-15' (V-2)	A/?	08-27-86	--	--	--	<2.25000	<0.10000
SD, 20-25' (V-2)	A/?	08-27-86	--	--	--	<2.05000	<0.10000
SD, 5,10' (V-3)	W/?	11-05-86	--	--	--	<0.20500	<1.00000
SD, 10,15' (V-3)	W/?	11-05-86	--	--	--	<0.20500	<1.20000
SD, 26' (V-3)	W/?	11-05-86	--	--	--	<2.00500	<1.00000
S4 (V-4) 14 - 15.5'	S/8010	04-02-87	--	--	--	0.25000	--
S5 (V-4) 20 - 21.5'	S/8010	04-02-87	--	--	--	3.50000	--
S9 (V-4) 38.5 - 40'	S/8010	04-02-87	--	--	--	<0.25000	--
DRAINAGE SWALE BORINGS							
B-1,R-2	S/8010	06-18-87	ND	ND	--	0.41000	ND
B-1,R-6	S/8010	06-18-87	ND	ND	--	ND	ND
B-2,R-1	S/8010	06-18-87	ND	ND	--	1.10000	ND
B-2,R-2	S/8010	06-18-87	ND	ND	--	ND	ND
B-2,R-4	S/8010	06-18-87	ND	ND	--	ND	ND
B-2,R-6	S/8010	06-18-87	ND	ND	--	1.80000	ND
B-3,R-1	S/8010	06-18-87	ND	ND	--	2.40000	ND
B-3,R-4	S/8010	06-18-87	ND	ND	--	ND	ND
B-3,R-6	S/8010	06-18-87	ND	ND	--	0.35	ND
B-4,R-1	S/8010	06-18-87	ND	ND	--	1.10000	ND
B-4,R-3	S/8010	06-18-87	ND	ND	--	ND	ND
B-4,R-4	S/8010	06-18-87	ND	ND	--	0.19000	ND
B-4,R-5	S/8010	06-18-87	ND	ND	--	ND	ND
B-4,R-6	S/8010	06-18-87	ND	ND	--	0.19000	ND
B-5,R-1	S/8010	06-18-87	ND	ND	--	ND	ND
B-5,R-3	S/8010	06-18-87	ND	ND	--	0.77000	ND
B-5,R-4	S/8010	06-18-87	ND	ND	--	ND	ND
B-5,R-5	S/8010	06-18-87	ND	ND	--	ND	ND
B-5,R-6	S/8010	06-18-87	ND	ND	--	ND	ND
B-6,R-1	S/8010	06-18-87	ND	ND	--	2.10000	ND
B-6,R-3	S/8010	06-18-87	ND	ND	--	0.99000	ND
B-6,4-4	S/8010	06-18-87	ND	ND	--	ND	ND
B-6,R-5	S/8010	06-18-87	ND	ND	--	0.72000	ND
B-6,R-6	S/8010	06-18-87	ND	ND	--	1.20000	ND
B-7,R-1	S/8010	06-18-87	ND	ND	--	0.25000	ND
B-7,R-2	S/8010	06-18-87	ND	ND	--	ND	ND
B-7,R-3	S/8010	06-18-87	ND	ND	--	ND	ND
B-7,R-4	S/8010	06-18-87	ND	ND	--	ND	ND
B-7,R-5	S/8010	06-18-87	ND	ND	--	ND	ND
B-7,R-6	S/8010	06-18-87	ND	ND	--	ND	ND
B-8,R-2	S/8010	06-18-87	3.90000	4.30000	170.00000	3,400.00000	ND
B-8,R-3	S/8010	06-18-87	ND	ND	--	2.40000	ND
B-8,R-4	S/8010	06-18-87	ND	ND	--	71.00000	ND
B-8,R-5	S/8010	06-18-87	ND	ND	--	0.79000	ND
B-8,R-6	S/8010	06-18-87	ND	ND	--	15.00000	ND

TABLE A-4 (Continued)

SAMPLE ID	METHOD/ LAB	SAMPLING DATE	PCP	TETRACHLORO- ETHENE	TOLUENE	1,1,1-TCA	TCE
SC, 0-15'(V-2)	A/?	08-27-86	0.20000	—	—	<0.25000	—
SC, 20-35'(V-2)	A/?	08-27-86	0.00660	—	—	<0.25000	—
SC, 5,10' (V-3)	W/?	11-05-86	—	—	—	<0.02500	—
SC, 10,15'(V-3)	W/?	11-05-86	—	—	—	<0.02500	—
SC, 30'(V-3)	W/?	11-05-86	—	—	—	<0.02500	—
S4 (V-4) 14 - 15.5'	S/8010	04-02-87	—	—	—	0.05700	<0.05000
S5 (V-4) 20 - 21.5'	S/8010	04-02-87	—	—	—	0.34000	<0.05000
S9 (V-4) 38.5 - 40'	S/8010	04-02-87	—	—	—	<0.05000	<0.05000
DRAINAGE SWALE BORINGS							
B-1,R-2	S/8010	06-10-87	—	ND	ND	0.29000	ND
B-1,R-6	S/8010	06-10-87	—	ND	ND	ND	ND
B-2,R-1	S/8010	06-10-87	—	ND	ND	ND	ND
B-2,R-2	S/8010	06-10-87	—	ND	ND	ND	ND
B-2,R-4	S/8010	06-10-87	—	ND	ND	ND	ND
B-2,R-6	S/8010	06-10-87	—	ND	ND	0.11000	ND
B-3,R-1	S/8010	06-10-87	—	ND	ND	0.56000	ND
B-3,R-4	S/8010	06-10-87	—	ND	ND	ND	ND
B-3,R-6	S/8010	06-10-87	—	ND	ND	0.15000	ND
B-4,R-1	S/8010	06-10-87	—	ND	ND	ND	ND
B-4,R-3	S/8010	06-10-87	—	ND	ND	ND	ND
B-4,R-4	S/8010	06-10-87	—	ND	ND	ND	ND
B-4,R-5	S/8010	06-10-87	—	ND	ND	ND	ND
B-4,R-6	S/8010	06-10-87	—	ND	ND	ND	ND
B-5,R-1	S/8010	06-10-87	—	ND	ND	ND	ND
B-5,R-3	S/8010	06-10-87	—	ND	ND	ND	ND
B-5,R-4	S/8010	06-10-87	—	ND	ND	ND	ND
B-5,R-5	S/8010	06-10-87	—	ND	ND	ND	ND
B-5,R-6	S/8010	06-10-87	—	ND	ND	ND	ND
B-6,R-1	S/8010	06-10-87	—	ND	ND	ND	ND
B-6,R-3	S/8010	06-10-87	—	ND	ND	ND	ND
B-6,4-4	S/8010	06-10-87	—	ND	ND	ND	ND
B-6,R-5	S/8010	06-10-87	—	ND	ND	ND	ND
B-6,R-6	S/8010	06-10-87	—	ND	ND	ND	ND
B-7,R-1	S/8010	06-10-87	—	ND	ND	ND	ND
B-7,R-2	S/8010	06-10-87	—	ND	ND	ND	ND
B-7,R-3	S/8010	06-10-87	—	ND	ND	ND	ND
B-7,R-4	S/8010	06-10-87	—	ND	ND	ND	ND
B-7,R-5	S/8010	06-10-87	—	ND	ND	ND	ND
B-7,R-6	S/8010	06-10-87	—	ND	ND	ND	ND
B-8,R-2	S/8010	06-10-87	—	15.00000	1,700.00000	ND	490.00000
B-8,R-3	S/8010	06-10-87	—	0.02670	1400.00000	1.59000	ND
B-8,R-4	S/8010	06-10-87	—	3.31000	61.00000	22.00000	0.55000
B-8,R-5	S/8010	06-10-87	—	ND	ND	2.37000	0.26000
B-8,R-6	S/8010	06-10-87	--	ND	ND	0.21000	ND

TABLE A-4 (Continued)

SAMPLE ID	METHOD/ LAB	SAMPLING DATE	VINYL CHLORIDE	XYLENE
SC, 0-15'(V-2)	A/?	08-27-86	—	—
SC, 20-35'(V-2)	A/?	08-27-86	—	—
SC, 5,10' (V-3)	W/?	11-05-86	—	—
SC, 10,15'(V-3)	W/?	11-05-86	—	—
SC, 36'(V-3)	W/?	11-05-86	—	—
S4 (V-4) 14 - 15.5'	S/8010	04-02-87	<0.05000	—
S5 (V-4) 20 - 21.5'	S/8010	04-02-87	<0.05000	—
S7 (V-4) 38.5 - 40'	S/8010	04-02-87	<0.05000	—
DRAINAGE SWALE BORINGS				
B-1,R-2	S/8010	06-18-87	—	ND
B-1,R-6	S/8010	06-18-87	—	ND
B-2,R-1	S/8010	06-18-87	—	ND
B-2,R-2	S/8010	06-18-87	—	ND
B-2,R-4	S/8010	06-18-87	—	ND
B-2,R-6	S/8010	06-18-87	—	ND
B-3,R-1	S/8010	06-18-87	—	ND
B-3,R-4	S/8010	06-18-87	—	ND
B-3,R-6	S/8010	06-18-87	—	ND
B-4,R-1	S/8010	06-18-87	—	ND
B-4,R-3	S/8010	06-18-87	—	ND
B-4,R-4	S/8010	06-18-87	—	ND
B-4,R-5	S/8010	06-18-87	—	ND
B-4,R-6	S/8010	06-18-87	—	ND
B-5,R-1	S/8010	06-18-87	—	ND
B-5,R-3	S/8010	06-18-87	—	ND
B-5,R-4	S/8010	06-18-87	—	ND
B-5,R-5	S/8010	06-18-87	—	ND
B-5,R-6	S/8010	06-18-87	—	ND
B-6,R-1	S/8010	06-18-87	—	ND
B-6,R-3	S/8010	06-18-87	—	ND
B-6,R-4	S/8010	06-18-87	—	ND
B-6,R-5	S/8010	06-18-87	—	ND
B-6,R-6	S/8010	06-18-87	—	ND
B-7,R-1	S/8010	06-18-87	—	ND
B-7,R-2	S/8010	06-18-87	—	ND
B-7,R-3	S/8010	06-18-87	—	ND
B-7,R-4	S/8010	06-18-87	—	ND
B-7,R-5	S/8010	06-18-87	—	ND
B-7,R-6	S/8010	06-18-87	—	ND
B-8,R-2	S/8010	06-18-87	—	ND
B-8,R-3	S/8010	06-18-87	—	91.00000
B-8,R-4	S/8010	06-18-87	—	1.70000
B-8,R-5	S/8010	06-18-87	—	ND
B-8,R-6	S/8010	06-18-87	—	ND

TABLE A-4 (Continued)

SAMPLE ID	METHOD/ LAB	SAMPLING DATE	ACETONE	BENZENE	CHLOROETHANE	1,1-DCA	1,1-DCE
WA-1 BELOW DIESEL TANK	S/5030/8020	10-02-87	--	3.00000	--	--	--
WA-2 EXCAVATION SIDEWALL	S/5030/8020	10-02-87	--	0.37000	--	--	--
R-1 PARKING LOT DRY WELL	S/8010	04-25-88	--	--	ND	ND	ND
R-2 EAST DRY WELL	S/8010	04-25-88	--	--	ND	ND	ND
R-3 WEST DRY WELL	S/8010/8020	04-25-88	--	ND	ND	ND	ND
DRAINAGE SWALE BORINGS							
B-9,R-1	S/8240/8240	04-05-88	16.30000	ND	ND	0.16000	ND
B-9,R-2	S/8240/8240	04-05-88	25.20000	ND	ND	2.20000	ND
B-9,R-3	S/8240/8240	04-05-88	1.50000	ND	ND	0.66000	ND
B-9,R-4	S/8240/8240	04-05-88	2.70000	ND	ND	0.23000	ND
B-9,R-5	S/8240/8240	04-05-88	12.10000	ND	ND	ND	ND
B-9,R-6	S/8240/8240	04-05-88	4.80000	ND	ND	ND	ND
B-10,R-7	S/8240/8240	04-05-88	ND	ND	ND	ND	ND
B-10,R-8	S/8240/8240	04-05-88	ND	ND	ND	ND	ND
B-10,R-9	S/8240/8240	04-05-88	ND	ND	ND	ND	ND
B-10,R-10	S/8240/8240	04-05-88	ND	ND	ND	ND	ND
B-10,R-11	S/8240/8240	04-05-88	ND	ND	ND	ND	ND
B-10,R-12	S/8240/8240	04-05-88	ND	ND	ND	ND	ND
B-11,R-13	S/8240/8240	04-05-88	2.50000	ND	ND	ND	ND
B-11,R-14	S/8240/8240	04-05-88	ND	ND	ND	ND	ND
B-11,R-15	S/8240/8240	04-05-88	ND	ND	ND	ND	ND
B-11,R-16	S/8240/8240	04-05-88	ND	ND	ND	ND	ND
B-11,R-17	S/8240/8240	04-05-88	ND	ND	ND	ND	ND
B-11,R-18	S/8240/8240	04-05-88	ND	ND	ND	ND	ND
B-12,R-19	S/8240/8240	04-05-88	ND	ND	ND	ND	ND
B-12,R-20	S/8240/8240	04-05-88	ND	ND	ND	ND	ND
B-12,R-21	S/8240/8240	04-05-88	ND	ND	ND	ND	ND
SB-2,R-1	S/8240/8240	04-05-88	0.22000	ND	ND	2.60000	ND
SB-3,R-1	S/8240/8240	04-05-88	91.20000	ND	ND	47.00000	ND
SB-4,R-1	S/8240/8240	04-05-88	23.00000	ND	ND	7.30000	ND
SB-7,R-1	S/8240/8240	04-05-88	ND	ND	ND	0.44000	ND
SB-1	S/5030/8240	05-24-88	1.10000	ND	ND	0.54000	ND
SB-5	S/5030/8240	05-24-88	ND	ND	ND	ND	ND
SB-6	S/5030/8240	05-24-88	17.00000	ND	ND	ND	ND
SB-8	S/5030/8240	05-24-88	1.20000	ND	ND	ND	ND
SB-9	S/5030/8240	05-24-88	49.30000	ND	ND	0.61000	ND
SB-10	S/5030/8240	05-24-88	180.00000	ND	ND	0.36000	ND
SB-11	S/5030/8240	05-24-88	ND	ND	ND	ND	ND
SB-12	S/5030/8240	05-24-88	14.20000	ND	ND	ND	ND
SB-13	S/5030/8240	05-24-88	1.20000	ND	ND	ND	ND
SB-14	S/5030/8240	05-24-88	ND	ND	ND	ND	ND
SB-15	S/5030/8240	05-24-88	ND	ND	ND	ND	ND

TABLE A-4 (Continued)

SAMPLE ID	METHOD/ LAB	SAMPLING DATE	1,2-DCA	TRANS 1,2-DCE	ETHYLBENZENE	METHYLENE CHLORIDE	MEK
EXCAVATION SIDEWALL	S/8020/8020	10-02-87	--	--	--	--	--
R-1 PARKING LOT DRY WELL	S/8010	04-25-88	ND	ND	--	ND	ND
R-2 EAST DRY WELL	S/8010	04-25-88	ND	ND	--	ND	ND
R-3 WEST DRY WELL	S/8010/8020	04-25-88	ND	ND	ND	ND	ND --
DRAINAGE SWALE BORINGS							
B-9,R-1	S/8240/8240	04-05-88	ND	ND	ND	9.3	--
B-9,R-2	S/8240/8240	04-05-88	ND	ND	3.00000	42.00000	--
B-9,R-3	S/8240/8240	04-05-88	ND	ND	4.20000	21.00000	--
B-9,R-4	S/8240/8240	04-05-88	ND	ND	ND	7.40000	--
B-9,R-5	S/8240/8240	04-05-88	ND	ND	ND	16.00000	--
B-9,R-6	S/8240/8240	04-05-88	ND	ND	ND	15.00000	--
B-10,R-7	S/8240/8240	04-05-88	ND	ND	0.22000	ND	--
B-10,R-8	S/8240/8240	04-05-88	ND	ND	ND	ND	--
B-10,R-9	S/8240/8240	04-05-88	ND	ND	ND	ND	--
B-10,R-10	S/8240/8240	04-05-88	ND	ND	ND	ND	--
B-10,R-11	S/8240/8240	04-05-88	ND	ND	ND	ND	--
B-10,R-12	S/8240/8240	04-05-88	ND	ND	ND	ND	--
B-11,R-13	S/8240/8240	04-05-88	ND	ND	ND	ND	--
B-11,R-14	S/8240/8240	04-05-88	ND	ND	ND	ND	--
B-11,R-15	S/8240/8240	04-05-88	ND	ND	ND	ND	--
B-11,R-16	S/8240/8240	04-05-88	ND	ND	ND	ND	--
B-11,R-17	S/8240/8240	04-05-88	ND	ND	ND	ND	--
B-11,R-18	S/8240/8240	04-05-88	ND	ND	ND	ND	--
B-12,R-19	S/8240/8240	04-05-88	ND	ND	ND	ND	--
B-12,R-20	S/8240/8240	04-05-88	ND	ND	ND	ND	--
B-12,R-21	S/8240/8240	04-05-88	ND	ND	ND	ND	--
SB-2,R-1	S/8240/8240	04-05-88	ND	ND	ND	1.70000	--
SB-3,R-1	S/8240/8240	04-05-88	ND	ND	ND	210.00000	--
SB-4,R-1	S/8240/8240	04-05-88	ND	ND	2.10000	64.00000	--
SB-7,R-1	S/8240/8240	04-05-88	ND	ND	ND	ND	--
SB-1	S/5030/8240	05-24-88	ND	ND	ND	1.30000	ND
SB-5	S/5030/8240	05-24-88	ND	ND	ND	ND	ND
SB-6	S/5030/8240	05-24-88	ND	ND	0.09500	ND	ND
SB-8	S/5030/8240	05-24-88	ND	ND	ND	ND	ND
SB-9	S/5030/8240	05-24-88	ND	ND	1.20000	6.20000	1.30000
SB-10	S/5030/8240	05-24-88	ND	ND	0.50000	6.00000	1.70000
SB-11	S/5030/8240	05-24-88	ND	ND	ND	ND	ND
SB-12	S/5030/8240	05-24-88	ND	ND	0.30000	0.60000	1.30000
SB-13	S/5030/8240	05-24-88	ND	ND	0.20000	ND	ND
SB-14	S/5030/8240	05-24-88	ND	ND	ND	ND	ND
SB-15	S/5030/8240	05-24-88	ND	ND	ND	ND	ND

TABLE A-4 (Continued)

SAMPLE ID	METHOD/ LAB	SAMPLING DATE	PCP	TETRACHLORO-ETHENE	TOLUENE	1,1,1-TCA	TCE
BELOW DIESEL TANK	S/5020/8020	10-22-87	—	—	0.55000	—	—
WA-2 EXCAVATION SIDEWALL	S/5020/8020	10-22-87	—	—	0.77000	—	—
R-1 PARKING LOT DRY WELL	S/8010	04-25-88	--	ND	--	ND	ND
R-2 EAST DRY WELL	S/8010	04-25-88	—	ND	—	ND	ND
R-3 WEST DRY WELL	S/8010/8020	04-25-88	—	ND	0.39600	ND	ND
DRAINAGE SWALE BORINGS							
B-9,R-1	S/8240/8240	04-05-88	ND	ND	2.30000	0.34000	ND
B-9,R-2	S/8240/8240	04-05-88	ND	0.57000	32.00000	32.00000	1.40000
B-9,R-3	S/8240/8240	04-05-88	ND	1.30000	41.00000	29.00000	1.50000
B-9,R-4	S/8240/8240	04-05-88	ND	ND	0.27000	0.29000	ND
B-9,R-5	S/8240/8240	04-05-88	ND	ND	0.42000	ND	ND
B-9,R-6	S/8240/8240	04-05-88	ND	ND	ND	ND	ND
B-10,R-7	S/8240/8240	04-05-88	ND	ND	0.74000	ND	ND
B-10,R-8	S/8240/8240	04-05-88	ND	ND	ND	ND	ND
B-10,R-9	S/8240/8240	04-05-88	ND	ND	ND	ND	ND
B-10,R-10	S/8240/8240	04-05-88	ND	ND	ND	ND	ND
B-10,R-11	S/8240/8240	04-05-88	ND	ND	ND	ND	ND
B-10,R-12	S/8240/8240	04-05-88	ND	ND	ND	ND	ND
B-11,R-13	S/8240/8240	04-05-88	ND	ND	0.13000	ND	ND
B-11,R-14	S/8240/8240	04-05-88	ND	ND	ND	ND	ND
B-11,R-15	S/8240/8240	04-05-88	ND	ND	ND	ND	ND
B-11,R-16	S/8240/8240	04-05-88	ND	ND	ND	ND	ND
B-11,R-17	S/8240/8240	04-05-88	ND	ND	ND	ND	ND
B-11,R-18	S/8240/8240	04-05-88	ND	ND	ND	ND	ND
B-12,R-19	S/8240/8240	04-05-88	ND	ND	ND	ND	ND
B-12,R-20	S/8240/8240	04-05-88	ND	ND	ND	ND	ND
B-12,R-21	S/8240/8240	04-05-88	ND	ND	ND	ND	ND
SB-2,R-1	S/8240/8240	04-05-88	ND	ND	0.30000	2.60000	ND
SB-3,R-1	S/8240/8240	04-05-88	ND	ND	38.00000	47.00000	ND
SB-4,R-1	S/8240/8240	04-05-88	ND	17.00000	17.00000	7.30000	2.70000
SB-7,R-1	S/8240/8240	04-05-88	ND	0.31000	[illegible]	2.44000	ND
SB-1	S/5030/8240	05-24-88	ND	ND	ND	1.10000	ND
SB-5	S/5030/8240	05-24-88	ND	ND	ND	ND	ND
SB-6	S/5030/8240	05-24-88	ND	ND	1.60000	ND	ND
SB-8	S/5030/8240	05-24-88	ND	ND	ND	ND	ND
SB-9	S/5030/8240	05-24-88	ND	0.24000	2.20000	[illegible]	ND
SB-10	S/5030/8240	05-24-88	ND	ND	[illegible]	ND	ND
SB-11	S/5030/8240	05-24-88	ND	ND	ND	ND	ND
SB-12	S/5030/8240	05-24-88	ND	ND	1.20000	ND	ND
SB-13	S/5030/8240	05-24-88	ND	ND	1.20000	ND	ND
SB-14	S/5030/8240	05-24-88	ND	ND	ND	ND	ND
SB-15	S/5030/8240	05-24-88	ND	ND	ND	ND	ND

TABLE A-4 (Continued)

SAMPLE ID	METHOD LAB	SAMPLING DATE	VINYL CHLORIDE	XYLENE
BELOW DIESEL TANK	S/[illegible]	12-[illegible]-87	--	[illegible]
[illegible] EXCAVATION SIDEWALL	S/[illegible]	12-[illegible]-87	--	[illegible]
P-1 PARKING LOT DRY WELL	S/8010	04-[illegible]-88	ND	ND
P-2 EAST DRY WELL	S/8010	04-[illegible]-88	ND	ND
P-3 WEST DRY WELL	S/8010/8020	04-[illegible]-88	ND	0.03050
DRAINAGE SWALE BORINGS				
B-9,R-1	S/8240/8020	04-05-88	ND	0.45000
B-9,R-2	S/8240/8020	04-05-88	ND	10.00000
B-9,R-3	S/8240/8020	04-05-88	ND	27.00000
B-9,R-4	S/8240/8020	04-05-88	ND	ND
B-9,R-5	S/8240/8020	04-05-88	ND	ND
B-9,R-6	S/8240/8020	04-05-88	ND	ND
B-10,R-7	S/8240/8020	04-05-88	ND	2.10000
B-10,R-8	S/8240/8020	04-05-88	ND	ND
B-10,R-9	S/8240/8020	04-05-88	ND	ND
B-10,R-10	S/8240/8020	04-05-88	ND	ND
B-10,R-11	S/8240/8020	04-05-88	ND	ND
B-10,R-12	S/8240/8020	04-05-88	ND	ND
B-11,R-13	S/8240/8020	04-05-88	ND	0.27
B-11,R-14	S/8240/8020	04-05-88	ND	ND
B-11,R-15	S/8240/8020	04-05-88	ND	.ND
B-11,R-16	S/8240/8020	04-05-88	ND	ND
B-11,R-17	S/8240/8020	04-05-88	ND	ND
B-11,R-18	S/8240/8020	04-05-88	ND	ND
B-12,R-19	S/8240/8020	04-05-88	ND	ND
B-12,R-20	S/8240/8020	04-05-88	ND	0.76000
B-12,R-21	S/8240/8020	04-05-88	ND	0.17000
SB-2,R-1	S/8240/8020	04-05-88	ND	ND
SB-3,R-1	S/8240/8020	04-05-88	ND	27.00000
SB-4,R-1	S/8240/8020	04-05-88	ND	210.00000
SB-7,R-1	S/8240/8020	04-05-88	ND	0.31000
SB-1	S/5030/8240	05-24-88	ND	ND
SB-5	S/5030/8240	05-24-88	ND	ND
SB-6	S/5030/8240	05-24-88	ND	0.70000
SB-8	S/5030/8240	05-24-88	ND	ND
SB-9	S/5030/8240	05-24-88	ND	11.00000
SB-10	S/5030/8240	05-24-88	ND	4.60000
SB-11	S/5030/8240	05-24-88	ND	ND
SB-12	S/5030/8240	05-24-88	ND	2.00000
SB-13	S/5030/8240	05-24-88	ND	1.90000
SB-14	S/5030/8240	05-24-88	ND	ND
SB-15	S/5030/8240	05-24-88	ND	ND

S = Sequoia Analytical Laboratory
SEL = Scientific Environmental Laboratories
A = Anatec
ANA = Anametrix
W = Wesco Laboratories
ND = Compound Not Detected
-- = Compound Not Analyzed

601/602+ = EPA Methods 601 and 602, plus analysis for MEK and X
a = Includes 601/602+, EPA Method 624

INDICATOR CONTAMINANT WORKSHEETS AND TABLES

TABLE B-1

CONSTITUENTS IDENTIFIED DURING REMEDIAL INVESTIGATION

Contaminants	Detected Infrequently And/Or Very Low Concentrations
(c)1,2-Dichloroethene	
(t)1,2-Dichloroethene	
1,1,1-Trichloroethane	
1,1-Dichloroethane	
1,1-Dichloroethene	
1,2-Dichloroethane	
1-Methoxy, 2-Propanone Phenol	X
Acetone	
Benzene	
Bromodichloromethane	X
Carbon Tetrachloride	X
Chlorobenzene	X
Chloroethane	
Chloroform	X
Ethanol	X
Ethylbenzene	
Isopropanol	X
Methanol	X
Methyl Ethyl Ketone	
Methylene Chloride	
Miscellaneous Hydrocarbons	X
Pentachlorophenol	
Phenol	X
Tetrachloroethylene	
Toluene	
TPH as Diesel	X
TPH as Kerosene	X
TPH as Paint Thinner	X
Trichloroethene	
Vinyl Chloride	
Xylenes	

TABLE 8-2: CONCENTRATIONS OF CONTAMINANTS IDENTIFIED DURING REMEDIAL INVESTIGATION

Contaminant	GROUND WATER						SURFACE WATER					SOILS					
	Observed Concentration			Percent Detected	Maximum(1) Contaminant Level	State(2) Action Levels	Observed Concentration			Maximum Contaminant Level	State Action Levels	Observed Concentration			Percent Detected	STLC(3)	TTLC(4)
	Minimum mg/l	Maximum mg/l	Mean mg/l	%	mg/l	mg/l	Minimum mg/l	Maximum mg/l	Mean mg/l	mg/l	mg/l	Minimum mg/kg	Maximum mg/kg	Mean mg/kg	%	mg/l	mg/kg
Acetone	3.00E-03	1.80E+00	1.03E-01	17.07	-(5)	-	ND(6)	2.90E-01	2.90E-01	-	-	1.20E+00	2.70E+02	9.28E+00	37.29	-	-
Benzene	1.90E-03	2.00E-02	6.43E-03	7.50	5.0E-03	7.0E-04	ND	ND	ND	5.00E-03	7.00E-04	3.90E-01	3.00E+00	5.47E-01	4.29	-	-
Chloroethane	3.10E-03	5.00E-01	4.49E-02	32.00	-	1.0E-04	ND	ND	ND	-	1.00E-04	ND	ND	ND	ND	-	-
1,1-DCA	6.90E-04	2.20E+00	5.36E-02	66.23	-	2.0E-02	3.00E-03	5.60E-02	7.89E-03	-	2.00E-02	1.60E-01	3.40E+01	8.83E-01	22.08	-	-
1,1-DCE	5.00E-04	5.00E-01	1.35E-02	44.00	7.0E-03 *	6.0E-03	ND	ND	ND	7.00E-03 *	6.00E-03	ND	1.30E+01	1.30E+01	1.30	-	-
1,2-DCA	1.00E-03	2.58E+00	2.57E-02	11.11	5.0E-03 *	1.0E-03	ND	ND	ND	5.00E-03 *	1.00E-03	ND	3.90E+00	3.90E+00	1.35	-	-
1,2-DCE	1.40E-03	1.30E-02	4.71E-03	19.40	-	1.6E-03	ND	ND	ND	-	1.60E-03	ND	4.80E+00	4.80E+00	1.35	-	-
Ethylbenzene	7.60E-03	5.70E-02	1.73E-02	10.34	-	6.8E-01	ND	ND	ND	-	6.80E-01	9.80E-02	1.70E+01	1.15E+00	26.32	-	-
Methylene Chloride	8.00E-04	1.42E+02	2.84E-01	41.46	-	4.0E-02	1.40E-02	1.30E+00	4.68E-02	-	4.00E-02	1.90E-01	3.40E+03	3.64E+00	41.46	-	-
MEK	2.10E-03	1.00E+00	2.39E-02	17.39	-	3.0E-02	ND	ND	ND	-	3.00E-02	1.30E+00	1.90E+00	1.64E+00	5.56	-	-
PCP	2.00E-04	5.00E-02	1.22E-03	45.45	-	3.0E-02	ND	2.00E-01	2.00E-01	-	3.00E-02	8.60E-03	2.00E-01	4.15E-02	5.26	-	-
Tetrachloroethylene	6.00E-03	8.00E-03	6.60E-03	9.68	-	4.0E-03	ND	ND	ND	-	4.00E-03	6.70E-03	1.70E+01	6.51E-01	10.81	-	-
Toluene	3.00E-03	3.60E-01	3.35E-02	17.86	-	1.0E-01	ND	ND	ND	-	1.00E-01	9.80E-02	1.70E+03	3.67E+00	29.73	-	-
1,1-TCA	5.00E-04	2.04E+00	3.39E-02	63.64	2.0E-01 *	2.0E-01	1.30E-02	7.00E-01	4.25E-02	2.00E-01 *	2.00E-01	5.70E-02	4.70E+01	1.07E+00	24.39	-	-
TCE	5.00E-04	5.00E-01	8.93E-03	11.94	5.0E-03 *	5.0E-03	ND	ND	ND	5.00E-03 *	5.00E-03	8.80E-02	4.90E+02	1.87E+00	7.79	2.04E-01	2.04E+03
Vinyl Chloride	6.00E-04	5.00E-01	4.16E-03	19.70	1.0E-03 *	2.0E-03	ND	ND	ND	1.00E-03 *	2.00E-03	ND	ND	ND	ND	-	1.00E+01
Xylene	8.00E-03	6.00E-02	2.63E-02	17.07	-	6.2E-01	ND	9.80E-03	9.80E-03	-	6.20E-01	1.70E-01	2.10E+02	3.43E+00	26.32	-	-

1. Maximum Contaminant Level set By Federal Safe Drinking Water Act (40 CFR 141.11(b)).
2. California State Action Levels, 1987.
3. Soluable Threshold Limit Concentrations, California Department of Health Services, 1987.
4. Total Threshold Limit Concentrations, California Department of Health Services, 1987.
5. Not applicable.
6. Not detected.
7. *Proposed value.

TABLE B-3
INDICATOR CONTAMINANT SELECTION TOXICITY IDENTIFICATION

Contaminant	Toxicologic Class	Rating Value[4] EPA Category[5]	WT[6] l/mg	ST[7] kg/mg
Acetone	NC[1]	5	1.67E-02	8.36E-07
Benzene	PC[2]	A	7.71E-03	3.86E-07
	NC	5	1.17E-01	5.85E-06
Chloroethane	NA[3]	NA	NA	NA
1,1-DCA	NC	7	2.58E-02	1.29E-06
1,1-DCE	PC	C	1.23E-01	6.14E-06
	NC	7	3.71E-01	1.86E-05
1,2-DCA	PC	B2	5.86E-02	2.93E-01
	NC	10	1.76E-02	8.80E-07
1,2-DCE	NC	5	5.29E-02	2.65E-06
Ethylbenzene	NC	4	1.10E-02	5.52E-07
Methylene Chloride	PC	B2	NA	NA
	NC	10	9.05E-02	4.52E-06
MEK	NC	10	7.75E-03	3.87E-07
PCP	PC	B2[8]	NA	NA
	NC	8	2.70E-01	1.30E-05
Tetrachlorethene	PC	B2	8.86E-03	4.43E-07
	NC	7	9.62E-03	4.81E-07
Toluene	NC	7	5.20E-03	2.60E-07
1,1,1-TCA	NC	2	7.33E-04	3.67E-08
TCE	PC	B2	4.29E-03	2.14E-07
	NC	5	1.05E+00	5.26E-02
Vinyl Chloride	PC	A	4.29E-03	2.14E-07
	NC	10	8.77E-02	4.39E-06
Xylene	NC	10	4.39E-03	2.20E-07

1. Potential carcinogen.
2. Non-carcinogen.
3. Not applicable.
4. Rating value is for severity of effect for non-carcinogens, range 1 (low) to 10 (high).
5. EPA Weight of evidence:
   - A - Human carcinogen. Sufficient evidence from epidemiologic studies to support a casual association between exposure and cancer.
   - B2 - Probable human carcinogen: sufficient evidence of carcinogenicity in animals, inadequate evidence of carcinogenicity in humans.
   - C - Possible human carcinogen: limited evidence of carcinogenicity in animals.
   - D - Not Classified: inadequate evidence of carcinogenicity in animals.
6. Toxicity constant for water.
7. Toxicity constant for soil.
8. EPA has tentatively classified PCP as a B2 based on the results of the NTP (1988) study.

Source: Superfund Public Health Evaluation Manual (USEPA 1986).
Public Health Risk Evaluation Database (USEPA 1988).

TABLE B-4

INDICATOR CONTAMINANT SELECTION

IDENTIFIED CONTAMINANTS WITH LIMITED TOXICOLOGICAL DATA

Contaminant	Media Observed
Chloroethane	Ground Water

TABLE B-5
INDICATOR CONTAMINANT SELECTION
CARCINOGEN RANKING

Contaminant	Ground Water CT[1] Maximum	Ground Water CT[1] Representative	Soil CT[2] Maximum	Soil CT[2] Representative	Indicator Score Value Maximum	Indicator Score Value Representative	Tentative Rank Maximum	Tentative Rank Representative
1,1-DCE	6.15E-02	1.66E-03	8.00E-05	8.00E-05*	6.16E-02	1.74E-03	3	2
1,2-DCA	1.51E-01	1.51E-03	1.00E-05	1.00E-05*	1.51E-01	1.52E-03	1	1
Benzene	1.50E-04	5.00E-05	1.16E-06	2.11E-07	1.50E-04	5.00E-05	6	5
Methylene Chloride	1.31E-01	2.60E-04	1.60E-04	1.67E-07	1.31E-01	2.60E-04	2	3
TCE	2.15E-03	4.00E-05	1.00E-04	4.00E-07	2.25E-03	4.00E-05	4	6
Tetrachloroethylene	7.00E-05	6.00E-05	1.00E-05	2.88E-07	8.00E-05	6.0E-05	7	4
Vinyl Chloride	2.15E-03	2.00E-05	ND[3]	ND	2.15E-03	2.00E-05	5	7

1. CT: Concentration x Toxicity factor for Water (^{W}T).
2. CT: Concentration x Toxicity factor for Soil (^{S}T).
3. Not detected.

* Based on one detection in soil.

Source: Superfund Public Health Evaluation Manual, 1986.
Public Health Risk Evaluation Database, September 1988.

TABLE B-6
INDICATOR CONTAMINANT SELECTION
NON-CARCINOGEN RANKING

Contaminant	Ground Water CT[1] Maximum	Ground Water CT[1] Representative	Soil CT[2] Maximum	Soil CT[2] Representative	Indicator Score Value Maximum	Indicator Score Value Representative	Tentative Rank Maximum	Tentative Rank Representative
1,1-DCA	5.68E-02	1.38E-03	4.00E-05	1.14E-06	5.68E-02	1.38E-03	4	4
1,1-DCE	1.86E-01	5.02E-03	2.40E-04	2.40E-04*	1.86E-01	5.26E-03	2	2
1,2-DCA	4.54E-02	4.50E-04	3.43E-06	3.43E-06*	4.54E-02	4.50E-04	5	6
1,2-DCE	6.90E-04	2.50E-04	1.00E-05	1.00E-05*	7.00E-04	2.60E-04	13	10
1,1,1-TCA	1.50E-03	2.00E-05	1.72E-06	3.93E-08	1.50E-03	2.00E-05	12	16
Acetone	3.01E-02	1.73E-03	2.30E-04	1.00E-05	3.03E-02	1.74E-03	7	3
Benzene	2.34E-03	7.50E-04	2.00E-05	3.20E-06	2.36E-03	7.50E-04	10	15
Ethylbenzene	6.30E-04	1.90E-04	1.00E-05	6.34E-07	6.40E-04	1.90E-04	14	12
Methylene Chloride	1.31E-01	2.60E-04	1.60E-04	1.67E-07	1.31E-01	2.60E-04	3	9
MEK	7.75E-03	1.90E-04	7.35E-07	6.35E-07	7.75E-03	1.90E-04	9	11
PCP	1.35E-02	3.30E-04	2.60E-06	5.39E-07	1.35E-02	3.30E-04	8	8
TCE	5.25E-01	9.38E-03	2.57E-02	1.00E-04	5.51E-01	9.48E-03	1	1
Tetrachloroethylene	8.00E-05	6.00E-05	1.00E-05	3.13E-07	9.00E-05	6.00E-05	16	15
Toluene	1.87E-03	1.70E-04	4.40E-04	9.55E-07	2.31E-03	1.70E-04	11	13
Vinyl Chloride	4.38E-02	3.60E-04	ND	ND	4.38E-02	3.60E-04	6	7
Xylene	2.60E-04	1.20E-04	5.00E-05	7.55E-07	3.10E-04	1.20E-04	15	14

1. CT: Concentration x Toxicity factor for Water (^{W}T).
2. CT: Concentration x Toxicity factor for Soil (^{S}T).
3. Not detected.

* Based on one detection in soil.

Source: Superfund Health Evaluation Manual, 1986.

TABLE B-7
INDICATOR CONTAMINANT SELECTION

Chemical	Ranking(1) Potential Carcinogen	Ranking(1) Non-Carcinogen	Water Solubility (mg/l)	Vapor(2) Pressure (mm/Hg)	Organic Carbon Partitioning(3) Coefficient	IC(4)
1,2-DCA	1	5	8.52E+03	6.40E+01	14	X
1,1-DCE	3	2	2.25E+03	6.00E+02	65	X
TCE	4	1	1.10E+03	5.79E+01	126	X
Vinyl Chloride	5	6	2.67E+03	2.66E+03	57	X
Benzene	6	10	1.75E+03	9.52E+01	83	X
Tetrachloroethylene	7	16	1.50E+02	1.78E+01	364	X
Methylene Chloride	2	3	2.00E+04	3.62E+02	8.8	X
1,1-DCA	--	4	5.50E+03	1.82E+02	30	X
PCP	--	8	1.40E+01	1.10E-04	53000	X
Acetone	--	7	1.00E+06	2.70E+02	2.2	
1,2-DCE	--	13	6.30E+03	3.24E+02	59	
MEK	--	9	2.68E+05	7.75E+01	4.5	
Xylene	--	15	1.98E+02	1.00E+01	240	
Toluene	--	11	5.35E+02	2.81E+01	300	
1,1,1-TCA	--	12	1.50E+03	1.23E+02	152	
Ethylbenzene	--	14	1.52E+02	7.00E+00	1100	

(1) Ranked by maximum indicator score values.

(2) Larger numbers indicate higher volatility..

(3) Large numbers indicate greater attraction to soil.

(4) Indicator Contaminant:

Note: the top seven contaminants in each toxicological category were selected as indicator contaminants. Acetone was eliminated as an indicator contaminant. The reason for this being that exposure to acetone produces very similar effects to those exhibited as a result to exposure to other contaminants selected as indicator contaminants. The evidence for carcinogenicity of acetone in humans is inadequate therefore it is classified as a Class D Potential Carcinogen.

Source: Superfund Public Health Evaluation Manual, 1986.

TOXICOLOGICAL PROFILES

1,1-DICHLOROETHANE

Toxicity

1,1-Dichloroethane (1,1-DCA) has a molecular weight of 98.96, a solubility in water of 5500 mg/l at 20 C, and a half-life in water that is estimated to be 1.5 days (U.S. EPA, 1984b).

The toxicity of 1,1-DCA following inhalation exposure has not been reported in humans. Very few studies on animals have been completed, but exposures of 1000 ppm to cats revealed renal alterations when exposure was continued for five days per week for 13 weeks. Testing in rabbits, rats and guinea pigs did not produce similar effects. Subchronic and chronic oral exposure studies in rats have found that sustained high level exposure to 1,1-DCA produces a significant increase in mortality rate and associated renal damage (U.S. EPA, 1984b).

Reproductive and Developmental Toxicity

The only available data on the overall reproductive toxicity of 1,1-DCA shows that when rats are exposed to this compound during gestation, via inhalation, there is a significant alteration in bone ossification of the offspring (Schwetzer et al., 1974). There is no data available on the teratogenic or reproductive effects in humans.

Carcinogenicity

Bioassays conducted on rats have found that there is a significant increase in mammary adenocarcinoma incidence following chronic oral exposure to 1,1-DCA (U.S. EPA, 1984b). Studies on mice have found that there is a significantly increased incidence of benign endometrial stromal polyps (U.S. EPA, 1984b). Mutagenicity testing has produced both positive and negative results. Some carcinogenicity tests have also failed to find a relationship between 1,1-DCA and tumor incidence. 1,1-DCA has therefore been assigned as a Group D - Not Classified Chemical (U.S. EPA, 1984b).

Regulations

Regulation or Advisory	Value
[a]TWA - TLV	200 ppm
[b]TWA - STEL	250 ppm

[a]Time Weighted Average - Threshold Limit Value

[b]Time Weighted Average - Short-Term Exposure Level

1,2-DICHLOROETHANE

Toxicity

1,2-Dichloroethane (1,2-DCA) is also known as ethylene dichloride. It has a molecular weight of 99, a vapor pressure of 64 mm Hg at 20 C, and a half-life in water of 4-hours (U.S. EPA, 1984c).

Human data on the subchronic oral toxicity of 1,2-DCA are not available, and the only available animal data provide inconclusive evidence that effects on the immunological systems of rats and mice are due entirely to 1,2-DCA. However, subchronic inhalation studies in animals have identified the rabbit as the most resistant and guinea pig as the most sensitive to the adverse effects of 1,2-DCA. Concentrations of 400 ppm 1,2-DCA resulted in mortality of all guinea pigs within 2 - 40 exposures whereas 165 exposures produced little or no effect on rabbits (Spencer et al, 1951). Other effects on guinea pigs have been hepatomegaly, decreased body weight and hapatic degeneration.

Relevant data on the chronic oral toxicity of 1,2-DCA are available for animals but not humans. Large doses of 1,2-DCA given to rats have led to high mortality rates in males and females due to toxic, not carcinogenic effects. The same was found to be true for female mice only (U.S. EPA, 1984c). In contrast to subchronic studies, various chronic occupational exposures to 1,2-DCA have been documented. In most cases, inhalation of 1,2-DCA has produced symptoms such as nausea, vomiting, anorexia, irritation of the eyes and respiratory tract and in some cases, heart rate elevations, hepatomegaly and nervous disorders with chronic exposure (U.S. EPA, 1984c). Very few chronic inhalation studies on animals have been completed, and those that have do not offer support to the human toxicity data (U.S. EPA, 1984c).

Teratogenicity and Reproductive Effects

No data are available on the teratogenic effects of oral or inhaled 1,2-DCA in humans, or of oral 1,2-DCA in animals. The animal data available with respect to inhaled 1,2-DCA have been inconclusive and although there were fetotoxic results, these could not be distinguished from those caused by the maternal toxicity of 1,2-DCA (U.S. EPA, 1984c).

Carcinogenicity

Animal bioassays provide significant data on the carcinogenic potential of 1,2-DCA, although no human studies on either oral or inhalation exposure to 1,2-DCA and cancer have been completed. In a 1978 NCI study, it was found that oral doses of 1,2-DCA given to rats produce a significant increase in various tumors including hemangiosarcoma, and subcutaneous tissue fibroma in males, whereas in females, mammary adenocarcinoma incidence was significantly elevated. In addition, male and female mice showed an increased incidence of pulmonary alveolar/bronchide adenoma. However, subsequent inhalation studies by Maltoni et al (1980) on rats and mice, did not find a relationship between induction of tumors and treatment with 1,2-DCA. Dermal exposure to 1,2-DCA in mice also did not produce a skin tumor increase, but it was suggested to enhance the incidence of benign papilloma of the lungs (U.S. EPA, 1984c).

Supporting evidence for the potential carcinogenicity of 1,2-DCA is provided by mutagenicity testing. The only significant positive mutation experiments however have been in Drosophila melanogaster and in cultured Chinese hamster ovary cells. In the latter case, the 1,2-DCA was metabolically activated with rat hepatic S-9 fraction and this produced a 4-fold increase in mutagenic response (U.S. EPA, 1984c).

The U.S. EPA classify 1,2-DCA as a group B2 - Probable Human Carcinogen due to the lack of evidence of carcinogenicity in humans despite significant evidence in animals.

Regulations

Regulation or Advisory	Value
[a]One-day (10 kg)	740 mg/l
[a]Ten-day (10 kg)	740 mg/l
[a]Longterm (10 kg)	10,700 mg/l
[a](70 kg)	37,500 mg/l
[a]Lifetime (70 kg)	37,500 mg/l
[a]Proposed MCL	0.005 mg/l
[b]TLV - TWA	10 ppm (40 mg/m^3)

[a]Source: U.S. EPA, 1986

[b]Source: ACGIH, 1987 - 1988

1,1-DICHLORETHYLENE

Toxicity

1,1-DCE is commonly known as vinylidene chloride. It has a molecular weight of 96.94, a water solubility of 2,250 mg/l at 25 C, and a half-life, in water, of approximately 1 - 6 days (U.S. EPA, 1984d).

Animal studies, conducted since the early 1960s, have provided almost all of the information from which human health effects may be assessed. Subchronic oral toxicity data are unreliable, but subchronic inhalation data have revealed that continuous exposure to concentrations of up to 395 mg/m^3 result primarily in liver and kidney damage in rats, guinea pigs, and monkeys. Chronic exposure to 1,1-DCE in drinking water appears to produce adverse hepatic changes in female rats more so than in male rats, especially at low dose levels e.g. 50 ppm (U.S. EPA, 1984d). Liver necrosis, however, was noted amongst high dose male mice (NTP, 1982). Chronic inhalation studies in rats have shown no dose-response alterations with respect to body weight, mortality or clinical chemistry. In addition, minor hepatic alterations were reversed once the dose treatment ceased (McKenna et al, 1982).

Teratogenicity and Reproductive Effects

No human data are available in the literature with respect to teratogenicity or reproductive effects due to oral or inhalation exposure to 1,1-DCE. Oral studies on rats have been inconclusive, whilst inhalation studies on rats have found fetotoxic effects that may be due to the direct maternal toxicity of 1,1-DCE (Murray et al, 1979).

Carcinogenicity

Oral and inhalation exposure data on humans are not available in the literature. Animal bioassays with respect to oral treatment of rats and mice with 1,1-DCE have not found evidence of carcinogenicity. However, inhalation studies on rats and mice have demonstrated a possible relationship between mammary tumors in both species, and kidney tumors in male mice, to 1,1-DCE (Maltoni et al, 1980). Supporting data from mutagenicity assays has found 1,1-DCE induces mutations in *Escherichia coli*, *Bacillus subtilis* and *Salmonella typhimuium*, once activated metabolically, but not in cultured mammalian cells (U.S. EPA, 1984d). The current data have led the U.S. EPA to designate 1,1-DCE as a Group C - Possible Human Carcinogen, based on limited evidence of carcinogenicity in animals (U.S. EPA, 1986).

Regulations

Standard	Value
[a]TLV - TWA	5 ppm (20 mg/m^3)
[b]STEL	20 ppm (80 mg/m^3)
[c]Proposed MCL	0.007 mg/l

Source: ACGIH (American Conference of Governmental Industrial Hygienists), 1988.
[a]Threshold Limit Value - Time Weighted Average
[b]Short-Term Exposure Limit
[c]In U.S. EPA 1986

TRICHLOROETHYLENE

Toxicity

Trichloroethylene (TCE) is a colorless liquid at room temperature. It has a molecular weight of 131.40, a boiling point of 86.7 C and its water solubility at 25 C is 1.366 g/l (ATSDR, 1988b).

Inhalation exposure to TCE of 2900 ppm has produced lethality in humans and a single oral dose of 7000 mg/kg TCE has also been reported to be lethal to humans (ATSDR, 1988b). The systemic and target organ effects of inhalation exposure to TCE have been reported in humans. The primary target organ is the central nervous system (CNS). Symptoms have been reported to range from drowsiness and headache up to short-term memory loss, and vertigo as the doses were increased. Reports of hepatic and renal damage have been limited, and the exposure data were not quantified (ATSDR, 1988b). More information on the results of oral and inhalation exposure to TCE in animals is available.

Inhalation studies in rats and mice have found acute and intermediate-duration exposure produced liver enlargement, increased kidney weight and some hepatocellular alterations (Kjellstrand et al, 1983). Some reports of hematological changes following inhalation of TCE by rats exist, but these have not been well documented (ATSDR, 1988b).

Oral exposure studies have suggested that not only are the liver and kidney affected, but also the immune system. Acute oral exposure to TCE in mice produced inhibited cell-mediated immune reactions (Tucker et al, 1982). Hepatocellular hypertrophy was reported in mouse intermediate-duration oral studies, and renal alterations were found in chronically dosed mice and rats. In addition, continuous oral exposure to TCE in female mice and in rabbits produced significant immunotoxic response, such as inhibited bone marrow stem cell colonization (ATSDR, 1988b).

Teratogenicity and Reproductive Effects

There is inconclusive data available on the developmental toxicity of oral or inhaled TCE to humans. Inhalation studies in rats have found that TCE is fetotoxic (causing skeletal ossification abnormalities) rather than teratogenic.

Other effects include decreased fetal weight and increased litter resorption (Healy et al, 1982). The reproductive toxicity of oral exposure to TCE has been studied in mice and rats. The results showed that acute toxicity involved liver and kidney enlargement in rats, and specifically, intermediate exposure to doses of 1000 mg/kg/day caused alterations in male rat mating behavior. Mice showed a reduced perinatal survival rate (ATSDR, 1988b).

Carcinogenicity

Human studies on the carcinogenicity of TCE are reported in the literature for inhalation exposure but not oral exposure. In particular, several epidemiological studies completed between 1978 and 1985 found significant excesses of cancer above background with the exception of bladder cancer and lymphoma in one study (ATSDR, 1988b). Animal models have been used to assess TCEs potential carcinogenicity and it has been shown that inhalation of 150 ppm TCE by mice results in lung adenocarcinoma increases and 600 ppm exposure to rats causes an increased incidence of renal adenomas and carcinomas (Maltoni et al, 1886). Reports of increases in tumors at other sites include hepatocellular carcinomas and malignant lymphomas (ATSDR, 1988b).

Oral exposure to TCE in mice has provided evidence of increased hepatocellular carcinomas in several studies. Contrary to these findings, TCE did not induce carcinomas in male mice when given in water at dose rate of 8 mg/kg/day over the 61 week experimental period. Nor was TCE found to be carcinogenic to Swiss mice at levels of up to 2,400 mg/kg (ATSDR, 1988b).

Due to the lack of human data, despite the evidence of carcinogenicity in animals, the U.S. EPA classify TCE as a group B2 - Probable Human Carcinogen.

Regulations

Regulation or Advisory	Value
[a]Proposed MCL	0.005 mg/l (eff. 1/89)
[b]MCLG	0.0
8-hr. TWA	100 ppm
[c]TWA-TLV (ACGIH)	50 ppm
TWA (NIOSH)	25 ppm

Source: ATSDR, 1988b

[a]MCL - Maximum Contaminant Level

[b]MCLG - Maximum Contaminant Level Goal

[c]TWA - TLV: Time Weighted Average - Threshold Limit Value

BENZENE

Toxicity

Benzene is a clear, colorless liquid with a boiling point of 80.1 C at 760 mm Hg, a molecular weight of 78.11, and a solubility in water of 820 mg/l at 22 C (ATSDR, 1987).

Accidental inhalation of benzene by humans has led to limited information on its lethality. It has been suggested that a level of 20,000 ppm for 5-10 minutes (continuous exposure) is an acutely lethal dose (Sandmeyer, 1981). Studies on rats suggest benzene inhalation has a low acute toxicity. There is a wide range of oral lethal doses reported for humans, the highest being 428 mg/kg (ATSDR, 1987).

Oral and inhalation studies on rats and mice have led to the conclusion that the systems most affected by benzene are primarily the hematopoietic and immune systems, and in some instances, the nervous system (ATSDR, 1987). Bone marrow effects have been observed in both rats and mice. These effects include a depressed leukocyte count and an increased leukocyte alkaline phosphatase level following acute inhalation exposures of 50 ppm and 300 ppm benzene, respectively (Li et al, 1986). Human data have indicated that acute inhalation exposure of benzene results in symptoms such as headache at levels of 50 - 150 ppm and further increases in exposure levels produce more severe toxicity up to a level of approximately 20,000 ppm for 5 - 10 minutes which may be fatal (ATSDR, 1987). There has been some suggestion that sensitization to benzene may occur leading to strongly adverse effects on subsequent acute, low-level exposure (Aksoy et al, 1976).

Reproductive and Developmental Toxicity

Benzene has been found to be potentially fetotoxic to mice, with effects such as decreased fetal weight evident when exposed to approximately 155 ppm via inhalation. Rabbits exhibit similar effects at 313 ppm (ATSDR, 1987). Mice exposed to 300 ppm benzene for 13 weeks were found to have a degeneration of the testes, decreased sperm count and bilateral cysts were found in the ovaries of the females (Ward et al, 1985). No data are available on the oral or dermal exposure routes and no human data are available.

Carcinogenicity

Several epidemiological studies have been conducted since 1978 and these have been the basis for the assessment of the risk of leukemia from benzene exposure (ATSDR, 1987). Despite the limitations of the data, case histories were analyzed and animal study results interpreted in order to assess unit risk. Inhalation exposure data revealed a unit risk of 2.6 X 10-2 for leukemia. Mice exposed to benzene by govage were shown to develop tumors at doses of 25 and 50 mg/kg for 103 weeks (ATSDR, 1987). Due to the weight of evidence for the carcinogenicity of benzene from epidemiological studies, the U.S. EPA classify it as a Group A - Human Carcinogen.

Regulations

Regulation or Advisory	Value
[a]MCL (Drinking Water)	0.005 mg/l
[b]8-hr. TWA (Air)	1.0 ppm
[c]STEL (Air)	5.0 ppm
WHO International Lifetime Advisory (Drinking Water)	0.01 mg/l
[d]MCLG (Drinking Water)	0.0

[a]Maximum Contaminant Level (Regulation)
[b]Time-Weighted Average (Regulation)
[c]Short-term Exposure Limit (Regulation)
[d]Maximum Contaminant Level Goal (Advisory)

VINYL CHLORIDE

Toxicity

Vinyl chloride has a molecular weight of 62.5, it is a colorless, sweet-smelling gas with a melting point of -153.8 C and a solubility in water of 2763 mg/l at 25 C (ATSDR, 1988c).

Inhalation exposure to vinyl chloride has been reported as lethal in high (unquantified) concentrations, and animal studies on rats and mice have indicated that both inhalation and oral exposure to vinyl chloride decreases longevity. Lethal dose levels have been found to be 100,000 ppm, continuous exposure for 30 minutes, for guinea pigs (ATSDR, 1988). Human data are available for inhalation exposure to vinyl chloride with respect to target organ toxicity. The primary target appears to be the liver and CNS. In addition, animal studies indicate hepatotoxicity following acute inhalation exposure. No data are available on intermediate or chronic inhalation exposures, but for oral exposures in rats, hepatotoxicity was identified from a lifetime study (Feron et al., 1975).

Reproductive and Developmental Toxicity

There is no data in the literature on the reproductive or developmental toxicity of oral exposure to vinyl chloride. However, human data on inhalation exposure show that there may be an increased likelihood of fetal loss, and alterations in sexual function in both sexes (ATSDR, 1988c). However, the data are not quantified. Animal studies in rabbits and mice suggest that development effects do occur after acute and chronic exposure. A one-year rat study found testicular alterations following a 100 ppm intermittent exposure regime (ATSDR, 1988c).

Carcinogenicity

Occupational epidemiology has led to the association of vinyl chloride exposure via inhalation, with various tumors, including liver, brain, and lung (ATSDR, 1988c). Studies in rats and mice indicate that the carcinogenicity of vinyl chloride is manifested as an increased incidence in liver angiosarcomas in rats and lung cancer in mice, even at low level inhalation exposures such as 50 ppm (ATSDR, 1988c). In addition, lifetime dietary administration of vinyl chloride to rats has been shown to increase the incidence of hepatocellular carcinoma and lung tumors in males and females (ATSDR, 1988c). In genotoxicity tests, human lymphocytes tested positive for chromosomal aberrations, and Drosophila tested positive in recessive lethal tests. The U.S. EPA classify vinyl chloride as a Class A - Human Carcinogen (ATSDR, 1988c).

<u>Regulations</u>

Regulation or Advisory	Value
Maximum Contaminant Level (MCL); water	0.002 mg/l
[a]OSHA - 8hr-TWA; air	<1.0 ppm
[b]FDA - packing polymer for food	5 - 50 ppm
[c]ACGIH -8hr-TWA; air	0 ppm

Source: ATSDR, 1988c

[a]Occupational Safety and Health Administration

[b]Food and Drug Administration

[c]American Conference of Governmental Industrial Hygienists

TETRACHLOROETHYLENE

Toxicity

Tetrachloroethylene is a colorless liquid (at room temperature) with a molecular weight of 165.83, a boiling point of 121.2 C at 760 mm Hg, and a solubility in water of 150 mg/l at 25 C (ATSDR, 1988b).

Inhalation studies on the lethality of tetrachloroethylene in rats and mice have indicated decreased longevity in both species. At very high concentrations (1600 - 1750 ppm), over extended periods of exposure (14 days - 13 weeks), treatment-related mortality was found (ATSDR, 1988a). No human inhalation lethality data are available, however human oral exposure to tetrachloroethylene has been conflicting. The therapeutic use of the compound has led to a NOAEL (No-Observed-Adverse-Effect Level) of 60 mg/kg, but one case report has indicated a dose of approximately this size may be lethal (ATSDR, 1988a).

The primary target organs for tetrachloroethylene are the central nervous system (CNS), liver and kidney. Limited data on inhalation of the compound by humans has shown CNS effects ranging from dizziness to nausea and unconsciousness occur (ATSDR, 1988a). In addition, longer-term exposures produce more severe CNS effects, such as, ataxia and short-term memory loss (U.S. EPA, 1985). Inhalation exposure studies in mice have found hepatocellular changes occur under acute exposure conditions, as well as CNS changes. No acute oral exposure data for animals is available but human data on tetrachloroethylene used as an antihelminthic have also reported CNS symptoms such as exhilaration and narcotic effects (ATSDR, 1988a). Intermediate-duration and chronic studies in rats and mice have found hepatic and renal alterations occur, respectively (NCI, 1977)(Buben and O'Flaherty, 1985).

Reproductive and Developmental Toxicity

No data was available on the reproductive and developmental toxicity of oral exposure to tetrachloroethylene. Animal data on the results of inhalation exposure to the compound showed mice to have an increased number of embryotoxic effects, such as split sternebrae, and rats to have an increased percentage of fetal resorption (ATSDR, 1988a). Only mice exhibited reproductive alterations, that is, an increased frequency of abnormal sperm, when exposed to 500 ppm for 7-hr./day over 5 consecutive days (ATSDR, 1988a).

Carcinogenicity

Inhalation exposure to tetrachloroethylene has been found to result in an elevated mononuclear cell leukemia rate in rats of both sexes and an elevated hepatocellular carcinoma incidence in mice of both sexes (NTP, 1986). This latter effect on mice was found to be true in the 1977 NCI study on rats and mice. Due to the inadequacy of human data and the sufficient evidence of carcinogenicity in animals, the U.S. EPA classifies tetrachloroethylene as a Group B2 - Probable Human Carcinogen (ATSDR, 1988a).

Regulations

Regulation or Advisory	Value
[a]OSHA Permissible Exposure Level (PEL)	100 ppm (8-hr.TWA[b])
[c]EPA Health Advisories	
One-day (10 kg)	2.0 mg/l
Ten-day (10 kg)	2.0 mg/l
Long-Term (70 kg)	5.0 mg/l

Source: ATSDR, 1988a

[a]Occupational Safety & Health Administration

[b]Time Weighted Average

[c]U.S. EPA

METHYLENE CHLORIDE

Toxicity

Methylene chloride has a molecular weight of 84.0 g, and has a solubility in water of 13 kg/l at 25 C. Its half-life in water has been estimated to be between 1 - 6 days (U.S. EPA, 1984e).

There have not been any reports on the effects of oral exposure to methylene chloride in humans. The only animal study on oral subchronic exposure to animals defined a no-observed-effect-level (NOEL) of 12.5 mg/kg/day in rats (U.S. EPA, 1983). Subchronic inhalation exposure to methylene chloride in rats, mice and monkeys appears to be associated with liver and kidney lesions. Sensitivity to this compound seems to be greatest in rats (U.S. EPA, 1983). The occupational exposures to methylene chloride that have been reported involved symptoms ranging from mild lightheadedness to toxic encephalosia following 5 years of direct contact with the compound daily. However, a 1983 study (Ott et al.) found no increase in mortality, in men or women, due to cardiopulmonary disease or malignant neoplasm associated with methylene chloride exposure. Most epidemiological studies since 1980 have not found associations between methylene chloride exposure and incidence of cardiac alterations or CNS aberrations. Animal studies on the chronic inhalation of methylene chloride have found to produce hepatocellular changes in rats. These included foci of multinucleated hepatocytes and necrosis of various hepatic regions, in high-dose females and males respectively (U.S. EPA, 1984e). Not all animals respond to methylene chloride exposure to the same degree. Hamsters were reported to be less sensitive than rats with respect to evidence of toxicity (U.S. EPA, 1984e).

Reproductive and Developmental Toxicity

No data are currently available on the potential reproductive or developmental toxicity of methylene chloride to humans via oral or inhalation exposure. Animal studies on rats and mice have found significant reductions in fetal body weight and some accelerated bone development in the respective species (U.S. EPA, 1984e).

Carcinogenicity

There are no data available on the potential for carcinogenicity of methylene chloride in humans. Oral exposure bioassays on both rats and mice have found methylene chloride to produce a small but significant increase in the incidence of hepatocellular tumors leading the EPA to conclude the compound has "borderline" carcinogenicity (U.S. EPA, 1984e). Inhalation studies in rats have revealed that in some instances, there is a significant increase in the number of benign mammary tumors in females, and in liver tumors in both sexes (U.S. EPA, 1984). In addition to the liver tumors, mice were also found to have an elevated lung tumor incidence. Due to the lack of evidence of carcinogenicity in humans, the U.S. EPA classify methylene chloride as a B2 - Probable Human Carcinogen.

Regulations

Regulation or Advisory	Value
[a]TLV (ACGIH)	100 ppm
[b]STEL (ACGIH)	350 ppm
EPA - Ambient Water Quality Criteria	6 mg/l

[a]Threshold Limit Value (American Conference of Governmental Industrial Hygienists)

[b]Short-Term Exposure Limit

PENTACHLOROPHENOL

Toxicity

Pentachlorophenol (PCP) has a molecular weight of 266.35, a solubility in water of 14 mg/l at 20^{o}C, and a half-life in water of 14 days (U.S. EPA, 1984f).

Epidemiological studies have revealed a variety of adverse effects due to occupational exposure to PCP, but the routes of exposure (dermal, oral, or inhalation) were not separated. These effects include serum enzyme induction (Klemmer et al., 1980) and depressed kidney function, which may be partially reversible (Begley et al., 1977).

A number of studies have found that subchronic oral exposure to technical grade PCP contaminated with dibenzo-p-dioxin, produce effects in rats that were not seen in parallel experiments where pure PCP was used (Johnson et al., 1973; Goldstein et al., 1977; Kerkvliet et al., 1982). Schwetz et al. (1978) exposed groups of 27 male and 27 female rats to 0, 3, 10, or 30 milligrams purified PCP/kilogram body weight/day (mg/kg/day) for either 22 months (males) and 24 months (females). At the 30 mg/kg/day level of treatment, a reduced body weight gain and increased specific gravity of the urine were observed in females. Pigmentation of the liver and kidneys was observed in females exposed to 10 or 30 mg/kg/day, and in males exposed to 30 mg/kg/day.

Teratogenicity and Reproductive Effects

Although studies that have investigated the teratogenicity of orally administered PCP in rodents have failed to demonstrate teratogenicity, fetotoxic effects associated with delayed skeletal ossification were observed (Larsen et al., 1975). A study in which 10 male and 20 female rats were fed PCP 62 days prior to mating showed fetotoxic effects as well as maternal toxicity occurring at a level of 30 mg PCP/kg/day (Schwetz et al., 1978). Since PCP apparently does not cross the placental barrier, the observed fetotoxicity may be a reflection of maternal toxicity (Larsen et al., 1975).

No data are available on the teratogenic effects of inhaled PCP in humans or in animals.

Carcinogenicity

There is no convincing evidence from epidemiological studies to indicate that inhalation of PCP in any form produces cancer in humans (Fingerhut et al., 1974; Gilbert et al., 1981; Greene et al., 1978; Roberts, 1983; and Robinson et al., 1985). No data are available in regard to cancer in animals following PCP inhalation exposure.

The carcinogenicity of orally administered PCP has been tested in at least three separate studies using mice (BRL, 1968; NTP, 1988; Schwetz et al., 1978). The purity of the PCP tested varied between the studies. The NTP tested both TG-Penta, a composite mixture of three technical grades of PCP which was reported to be 90% pure, and Dowicide EC-9 a mixture containing 90% pure PCP and fewer dioxin impurities than the TG-Penta. BRL tested Dowicide EC-9 and Schwetz reportedly tested pure PCP.

No significant elevation in the incidence of cancer occurred in the BRL Dowicide EC-9 study; however in the NTP Dowicide EC-9 study significant increase in incidence of tumors were observed. Male mice displayed significant dose-related increases in the incidence of adrenal medulla pheochromocytomas (benign and malignant), heptacellular adenomas and carcinomas. Female mice in the high dose group displayed significant increases in the incidence of hepatocellular ademonma and carcinoma (benign and malignant) and in hemangiosarcomas (spleen and liver).

In the NPT study using TG-Penta male mice displayed a significant increase in tumors of the adermal medulla pheochromocytomas (benign and malignant) and liver adenomas and carcinomas. Female mice displayed significant increase incidence of hemangeosarcomas of the spleen and liver. A high level of dioxin were found to be a contaminant of the TG-Penta mixture. Dioxin exposure has been associated with an increased incidence of liver tumors in treated mice but not with pheochromocytomas or hemangiosarcomas (NCI/NTP 1980). The occurrence of the rare hemangiosarcomas was considered to be a carcinogenic response due to PCP exposure.

No significant increase in the incidence of tumors were observed during the Schwetz et al. study.

EPA has tentively classified PCP as a B2--probable human carcinogen--based on the results of the NTP (1988) study. This classification is not verified and, together with cancer potency factor, is currently being reviewed by EPA. (Personal communication with CRAVE workgroup).

Regulations

Standard	Value
[a]TLV-TWA	0.5 mg/m^3
[b]proposed MCLG	.22 mg/l
[c]Action Level	2.2 ug/l
[d]WQC	1.01 mg/l
EPA Health Advisory	
One-day (10kg)	1.0 mg/l
10-day (10kg)	0.3 mg/l
Long Term (70kg)	1.05 mg/l

[a]Threshold Limit Value-Time Weighted Average
[b]Propose Maximum Contaminant Level Goal
[c]California Action Level
[d]EPA Ambient Water Quality Criteria

SUMMARY OF GROUND WATER MODELING

CONTAMINANT TRANSPORT MODELING

Subsurface transport of contaminants beneath and downgradient of the Jasco site was modeled using two different types of models. A one-dimensional analytical model (Javandel et al., 1984) was utilized to simulate the leaching (vertical downward migration in the unsaturated zone) of contaminants through the unsaturated soil into the A-aquifer. The subsequent transport of contaminants within the A-aquifer (saturated zone) downgradient of the site was modeled using a numerical model, SUTRA (Voss, 1984). With the aid of these two models, the areal distribution of concentration of each contaminant in the A-aquifer downgradient of the site was projected over a period of 70 years.

Both models utilized available data from previous subsurface investigations at the site. Data which is not available, but required by the models, was estimated using documented procedures or obtained from published data.

UNSATURATED ZONE

Modeling of contaminant migration in the unsaturated zone was performed using the one-dimensional analytical model mentioned above. The model simulated the leaching of contaminants from near the ground surface down to the A-aquifer below as a result of recharge from precipitation. The recharge from precipitation acted as a transport mechanism for the vertical downward migration of contaminants. A time-dependent concentration profile for each contaminant in the leachate as it enters the A-aquifer was generated by the model for the entire period of simulation.

The location of Well V-2 at the drainage swale area was chosen for simulating the vertical downward migration of contaminants into the A-aquifer. The drainage swale area has the highest level of soil contamination as indicated by the available soil sampling data (Wahler Associates, August and June 1988). Most of the contaminants were found to occur with a high concentration at a depth of approximately three feet below the ground surface. The geologic cross-section of Well V-2, as depicted in the Aquifer Testing Report (Wahler Associates, December 1987), showed the thickness of the unsaturated zone to be about 32 feet.

Figure C-1 illustrates the cross-section through the unsaturated zone as utilized in the modeling.

Input parameters required by the model are the pore water velocity and coefficient of dispersion in the unsaturated zone. The pore water velocity was estimated using the equation by Enfield et al. (1982) (see Equation (2) in Calculation below) as described in the draft Superfund Exposure Assessment Manual (SEAM) (Schultz et al., 1986). A pore water velocity of 5.4×10^{-8} foot per second was obtained using a recharge (percolation) rate of eight inches per year and a saturated hydraulic conductivity of 4.8×10^{-6} foot per second. Harding Lawson Associates (1987) has estimated that approximately eight inches of precipitation are potentially available for recharge into the local aquifer annually. The saturated hydraulic conductivity is the average of the two values reported in the Phase II Hydrogeological Investigation (Wahler Associates, November 1987). The volumetric water content of the soil (required for calculating the pore water velocity) under a saturated condition is not available. Hence, it was obtained from the SEAM by assuming a silty clay soil for the unsaturated zone. This assumption was made based on information from the geologic cross-section (or boring log) for Well V-2. The coefficient of dispersion, which is the product of pore water velocity and longitudinal dispersivity, was calculated to be 1.7×10^{-7} foot square per second. Field data on the longitudinal dispersivity for the unsaturated zone is not available. Using the guideline from Gelhar and Axness (1981), the longitudinal dispersivity was estimated to be 3.2 feet by taking 10 percent of the distance to the ground water. The vertical downward migration of the contaminants was assumed to occur with no retardation or decay. This conservative assumption was made due to the lack of field data.

For the purpose of modeling, the length of the "chemical spill" period that resulted in the contamination of soil and ground water beneath the site needs to be evaluated. A constant source of solute (contaminant) was introduced into the soil together with the recharge from precipitation. Using the soil and ground water data for methylene chloride, a "chemical spill" period of approximately 14 years was determined to be required in order to reproduce the available soil and ground water data (3400 parts per million for soil and 142 parts per million for ground water). The data for methylene chloride was used as it has the highest reported concentration in both the soil and ground water. In addition, SUTRA was also

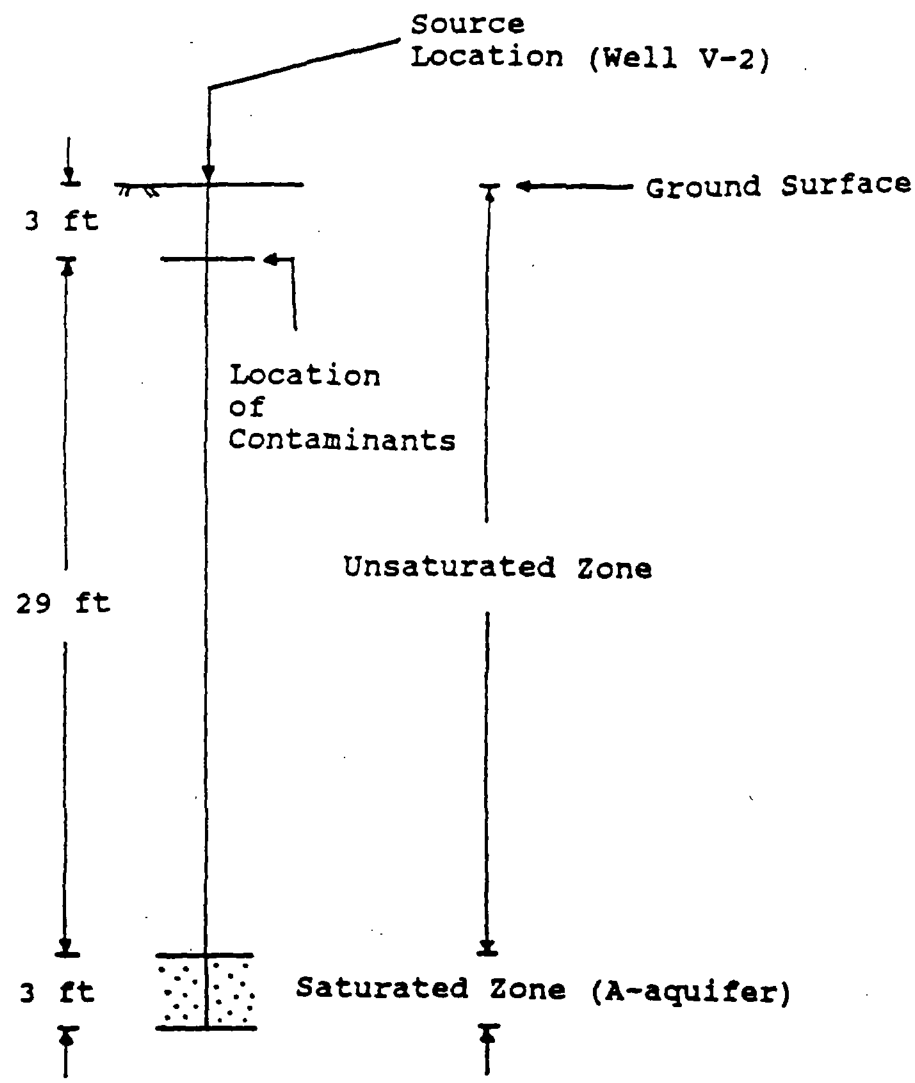


Figure C-1: Cross-Section through the Unsaturated Zone (As Modeled) utilized in determining this time period (see SATURATED ZONE below). Evaluation of the "chemical spill" period was done solely for the purpose of facilitating the modeling. It does not in any way imply that a continuous "chemical spill" has occurred over a period of 14 years.

Simulation of contaminant migration in the unsaturated zone was conducted in two stages. During the first stage (14 years), a constant source of contaminant was introduced into the soil together with the recharge from precipitation (as explained in the previous paragraph). The simulation continued into the second stage for a period of 70 years. The second stage simulated the leaching of contaminants from near the ground surface into the A-aquifer from precipitation. No contaminant was introduced into the soil during the second stage.

The simulation was conducted using each of the contaminants. Table C-1 shows the concentration value for each contaminant as used in the model simulation at a depth of three feet. These values represent the concentration in the soil at the end of the first stage simulation. Notice that the concentration value for four of the contaminants (1,2-DCA, vinyl chloride, 1,1-DCA, and PCP) used for model input differed from the reported values. A higher concentration value was necessary for these four contaminants in order to reproduce the concentration reported in the ground water (see Table C-1). The reason being that the same "chemical spill" period was assumed for all the contaminants.

The time-dependent concentration profile of each contaminant in the leachate at the base of the unsaturated zone was generated. Figure C-2 shows the time-dependent concentration profile of methylene chloride in the leachate prior to entering the A-aquifer.

TABLE C-1

Contaminant	Soil Concentration (ppm) Highest Value Reported	Soil Concentration (ppm) Value Used For Model Input (Unsaturated Zone)	Ground Water Concentration (ppm) Highest Value Reported	Ground Water Concentration (ppm) Value Used For Model Input (Saturated Zone)
1,1-DCE	13	13	0.17	0.54
1,2-DCA	3.9	62	2.58	2.58
Methylene Chloride	3400	3400	142	142
PCE	17	17	0.008	0.71
TCE	490	490	0.019	20
Vinyl Chloride	<0.05	0.38	0.016	0.016
Benzene	3.0	3.0	0.02	0.12
1,1-DCA	47	53	2.2	2.2
PCP	0.2	1.2	0.05	0.05

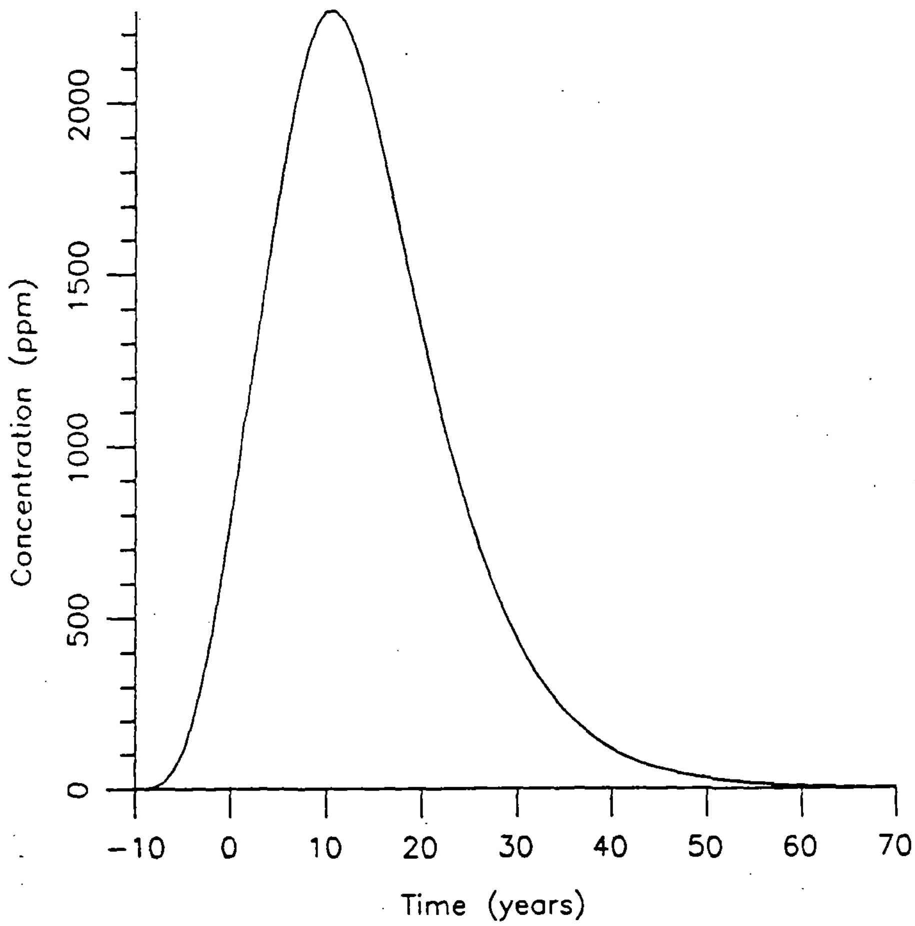


Figure C-2: Time-Dependent Concentration of Methylene Chloride Prior to Entering the A-Aquifer

Calculation

Given:

1) Recharge from precipitation, $q = 8$ in/year (2.1×10^{-8} ft/s).
2) Volumetric water content of soil under saturated conditions $O_S = 0.492$ (silty clay, Table C-2).
3) $b = 10.40$ (silty clay, Table C-2).
4) Saturated hydraulic conductivity, $k_S = 4.8 \times 10^{-6}$ ft/s (average of 7.9×10^{-6} and 1.7×10^{-6}).
5) Depth to ground water, $d = 32$ ft.

Required:

1) Volumetric water content of unsaturated zone, O.

$$O = O\,(q/k_S)^{(1/[2b + 3])} \quad (1)$$
$$= 0.492\,(2.1 \times 10^{-8}/4.8 \times 10^{-6})^{(1/0.042)}$$
$$= 0.39$$

2) Pore water velocity, V.

$$V = q/O \quad (2)$$
$$= ([2.1 \times 10^{-8} \text{ ft/s}]/[0.39])$$
$$= 5.4 \times 10^{-8} \text{ ft/s}$$

3) Longitudinal dispersivity, L.

$L = 0.1 \times 32 = 3.2$ ft.

4) Dispersion coefficient, D.

$$D = LV \quad (3)$$
$$= 3.2\,(5.4 \times 10^{-8})$$
$$= 1.7 \times 10^{-7} \text{ ft}^2\text{/s}$$

SATURATED ZONE

Migration of contaminants in the A-aquifer downgradient of the site was modeled using SUTRA. The numerical scheme employed by SUTRA enabled the simulation of the time-dependent concentration of the leachate entering the aquifer, and the

TABLE C-2*
REPRESENTATIVE VALUES OF HYDRAULIC PARAMENTERS
(STANDARD DEVIATION IN PARENTHESES)

Soil Texture	No. of Soils(a)	b(b)		$\frac{1}{2b+3}$	O_s(c)	
Sand	13	4.05	(1.78)	0.090	0.395	(0.056)
Loamy Sand	30	4.38	(1.47)	0.085	0.410	(0.068)
Sandy Loam	204	4.90	(1.75)	0.080	0.435	(0.086)
Silt Loam	384	5.30	(1.87)	0.074	0.485	(0.059)
Loam	125	5.39	(1.87)	0.073	0.451	(0.078)
Sandy Clay Loam	80	7.12	(2.43)	0.058	0.420	(0.059)
Silt Clay Loam	147	7.75	(2.77)	0.054	0.477	(0.057)
Clay Loam	262	8.52	(3.44)	0.050	0.476	(0.053)
Sandy Caly	19	10.40	(1.64)	0.042	0.426	(0.057)
Silt Clay	441	10.40	(4.45)	0.042	0.492	(0.064)
Clay	140	11.40	(3.70)	0.039	0.482	(0.050)

* Adapted from SEAM.

(a) Number of individual soil samples included in data compiled by Clapp and Hornberger (1978).

(b) Empirical parameter relating soil matric potential and moisture content; shown to be strongly dependent on soil texture.

(c) Volumetric soil moisture content (volume of water per volume of soil).

Source: Adapted from Clapp and Hornberger, 1978.

subsequent two-dimensional areal transport of the contaminants. The areal distribution of concentration of each contaminant was projected by the model over a period of 70 years.

Simulation of contaminant migration in the saturated zone using SUTRA necessitated the construction of a finite-element mesh (see Figure C-3). This mesh is to be placed over the region of the aquifer to be modeled. The mesh was designed to encompass the contaminant plume projected after 70 years. The longitudinal direction of the mesh was oriented in the direction of the regional ground water flow (N30^{o}E) as reported in the Phase II Hydrogeologic Investigation (Wahler Associates, November 1987). Each node on the mesh corresponds to a location in the aquifer. On-site monitoring wells (Wells V-1 through V-10) are represented by nodal points on the mesh.

Limited hydrogeologic data is available for use in simulating contaminant migration in the aquifer using the model. All known data points (on-site monitoring wells) are clustered in close proximity to the location of the source within a relatively small area compared to the size of the area being modeled. Due to the limited distribution of data points over the modeled area, a projection of data from a relatively small area to the remainder of the modeled area was performed. As such, the aquifer modeled will not be truly representative of the actual aquifer. This procedure was adopted in order to enable the simulation to be conducted with the limited amount of data. Results should be viewed with this in mind.

Aquifer parameters such as the initial piezometric head and ground water quality (background concentration), saturated thickness, effective porosity, hydraulic conductivity, and longitudinal and transverse dispersivities are required for input into the model. As in the case of the unsaturated zone modeling, the contaminants were assumed to migrate in the aquifer without any retardation or decay. The ground water was assumed to be clean prior to the "chemical spill".

The piezometric head for all the nodal points (with the exception of seven) was obtained by assuming a hydraulic gradient of 0.004 foot per foot (Wahler Associates, November 1987) along the assumed flow direction (N30^{o}E). Nodal

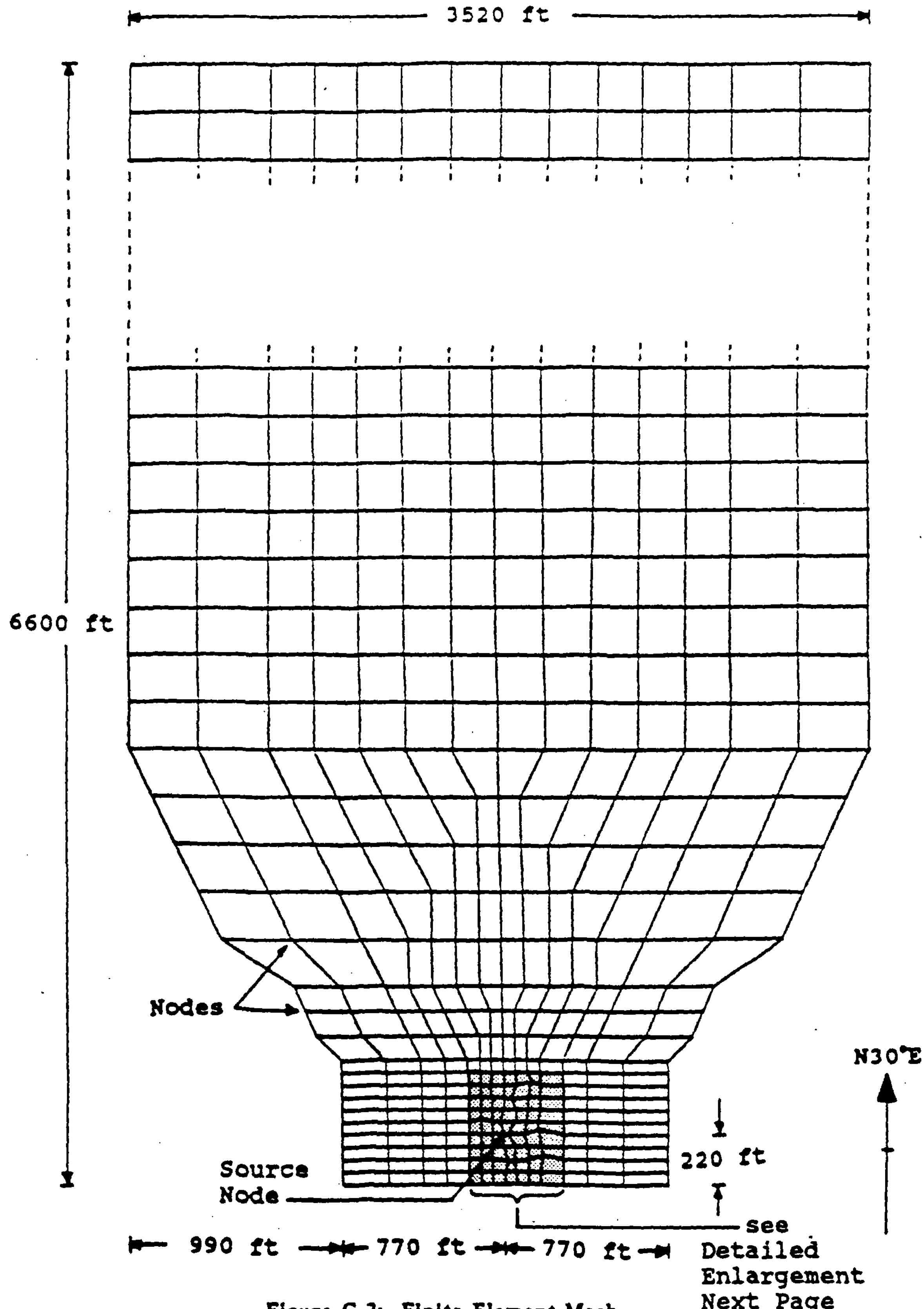


Figure C-3: Finite-Element Mesh

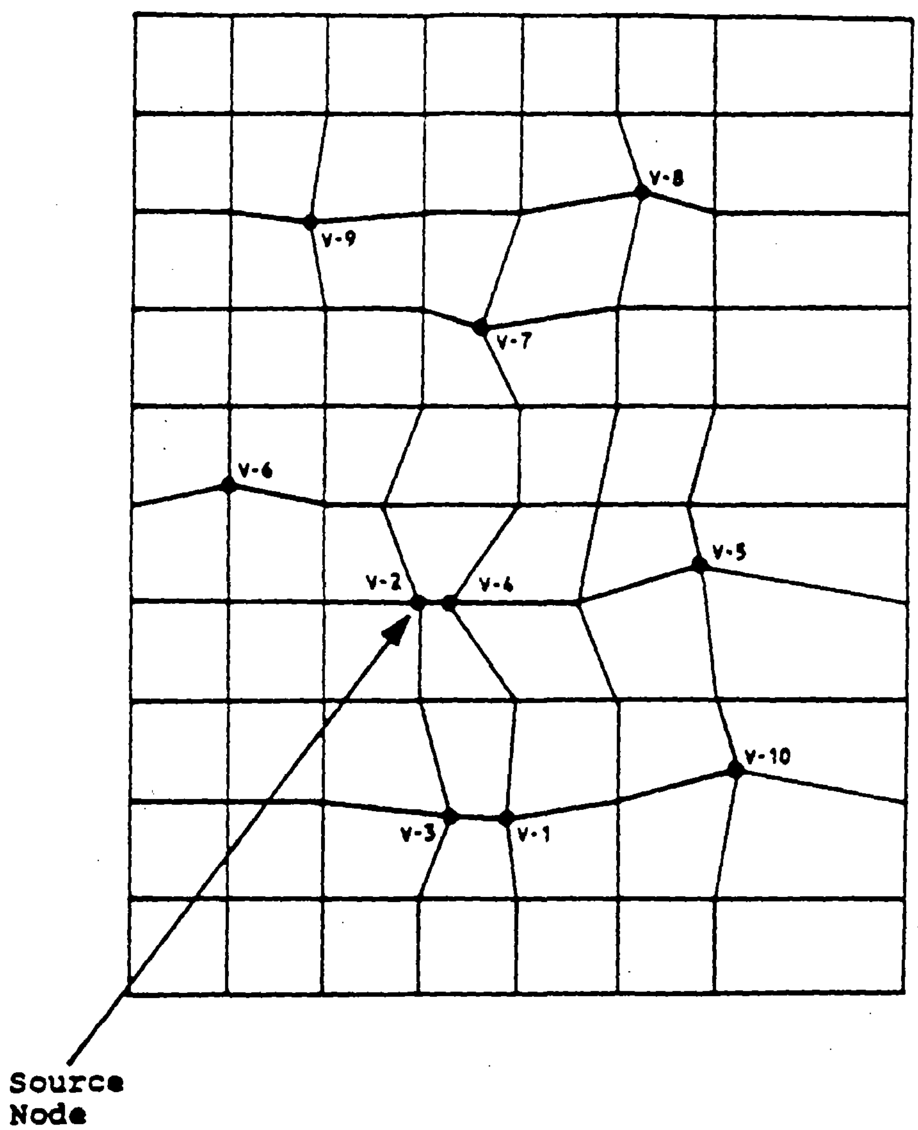


Figure C-3 (continued): Finite-Element Mesh
- Detailed Enlargement Showing Well Locations

points corresponding to Wells V-1 through V-7 were assigned the piezometric heads observed on October 7, 1987 (see Table C-3).

The saturated thickness throughout the A-aquifer was obtained from boring logs as well as values reported in the Aquifer Testing Report (see Table C-3). Only the nodal points corresponding to Well V-1 through V-10 possess values of the saturated thickness. Interpolation was performed to determine the saturated thickness within the area bounded by the 10 wells. For the rest of the nodal points, an average value of the saturated thickness (5.6 feet) was used.

A single value of hydraulic conductivity was used for the entire area being modeled. Hydraulic conductivity values are available from slug tests for Wells V-1 through V-7 (Aquifer Testing Report). A more reliable pump test on Well V-4 yielded a hydraulic conductivity value of 7.9×10^{-3} foot per minute which differed significantly from the slug test value of 1.5×10^{-2} foot per minute (Aquifer Testing Report). Since the pump test is a more reliable method and the fact that the slug test results for Wells V-1 through V-7 varied greatly from each other, the slug test results were not utilized. The effective porosity of the aquifer was assumed to be 0.4 as used in the Aquifer Testing Report (per Freeze and Cherry, 1979).

Dispersion of contaminants in an aquifer is described in part by the longitudinal and transverse dispersivities. Field data is not available for these parameters. A longitudinal dispersivity of 100 feet is given by Pettyjohn et al. (1982) for an alluvial sediment aquifer in California. The transverse dispersivity was computed as 30 feet by taking 30 percent of the longitudinal dispersivity (Konikow and Bredehoeft, 1978).

Simulation of contaminant migration in the aquifer by SUTRA was conducted in two stages similar to the unsaturated zone modeling. Results from the first stage simulation correspond to the highest reported concentration value of each contaminant in the aquifer (see Table C-1). As in the case of the unsaturated zone, a higher concentration value was used for some of the contaminants (1,1-DCE, PCE, TCE and benzene). The reason being that the unsaturated zone modeling predicted a higher concentration value in the ground water based on the available soil concentration data. Note that methylene chloride was used in determining the

TABLE C-3

Monitoring Well No.	Saturated Thickness(1) (ft)	Piezometric Head(2) (ft)
V-1	0.5	34.6
V-2	3.0	34.1
V-3	4.0	34.5
V-4	7.0	34.1
V-5	3.0	34.1
V-6	7.0	34.0
V-7	13.5	33.5
V-8	5.0	---
V-9	5.0	---
V-10	7.5	---

(1) From boring logs and the Aquifer Testing Report (Wahler Associates, December 1987).
(2) Taken on 10/7/87 (above mean sea level) (Wahler Associates, November 1987).

length of the "chemical spill" period to reproduce the concentration data in the soil and ground water. The same "chemical spill" period was assumed for the rest of the contaminants. The second stage simulation produced the areal distribution of concentration of each contaminant over a period of 70 years.

Figure C-4 shows the isoconcentration plot for each contaminant at the end of the 70-year period. The isoconcentration plot shows the migration of contaminants in the direction of the regional ground water flow as expected. At the end of the 70-year period, the predicted contaminant plume appeared to extend as far as 5,500 feet downgradient of the source as depicted by the methylene chloride plume. Laterally, the contaminant plume extends over a distance of approximately 2,900 feet (see Figure C-4, isoconcentration plot for methylene chloride). The outermost isoconcentration line in each plot represents the drinking water ingestion limit of the contaminant. The time-dependent concentration of methylene chloride at 55 feet and 2200 feet downgradient of the source is depicted in Figures C-5 and C-6 respectively.

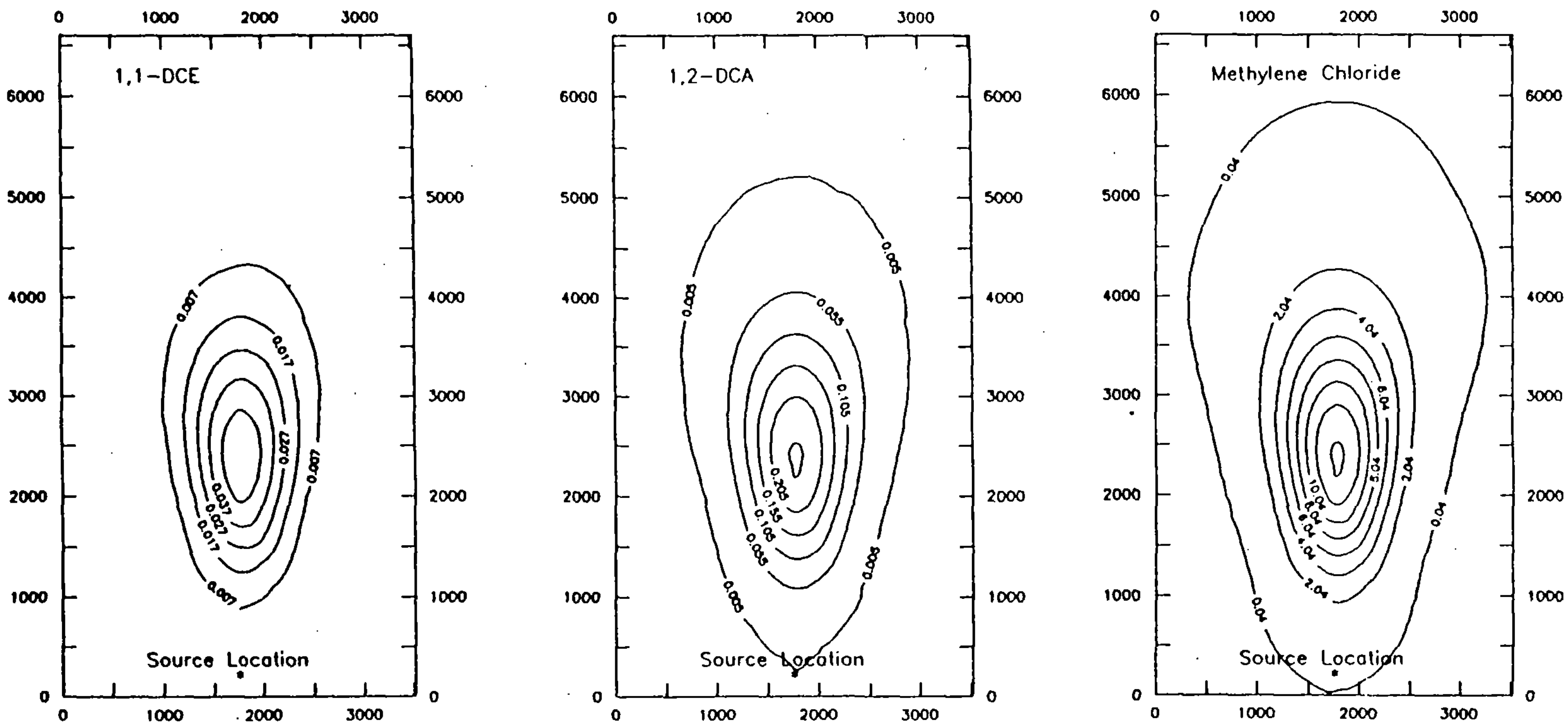


Figure C-4: Isoconcentration Plot for Each Contaminant at the End of the 70-Year Period (ppm)

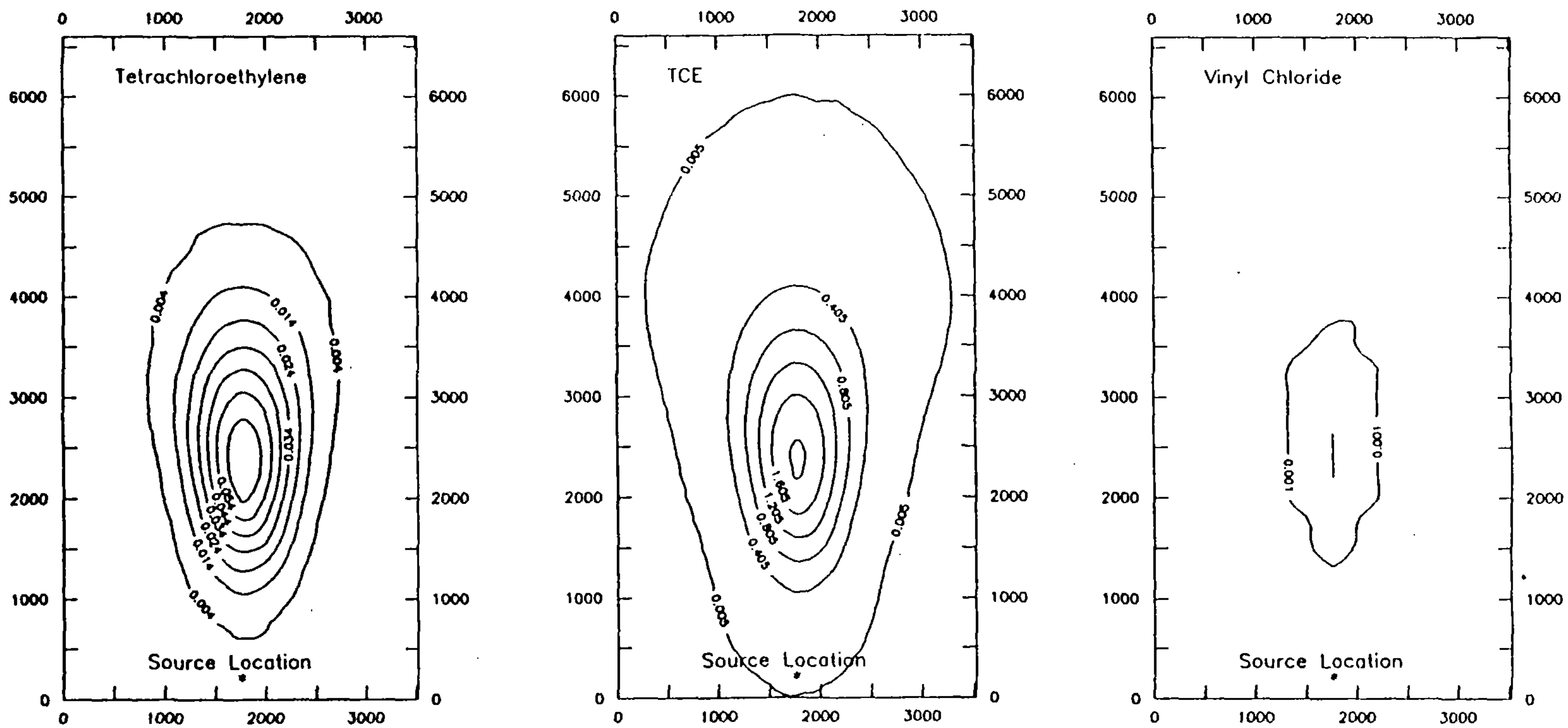


Figure C-4 (continued): Isoconcentration Plot for Each Contaminant At the End of the 70-Year Period (ppm)

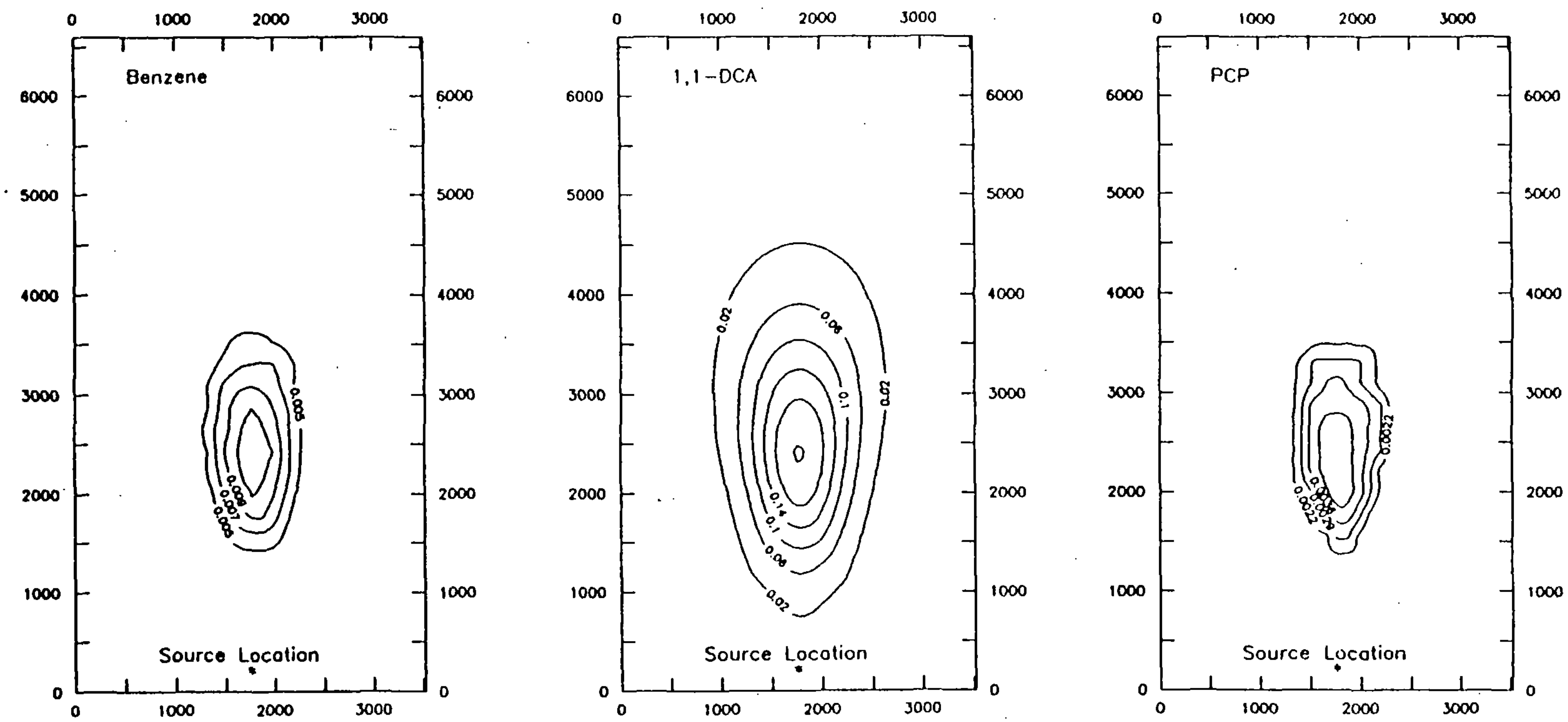


Figure C-4 (continued): Isoconcentration Plot for Each Contaminant At the End of the 70-Year Period (ppm)

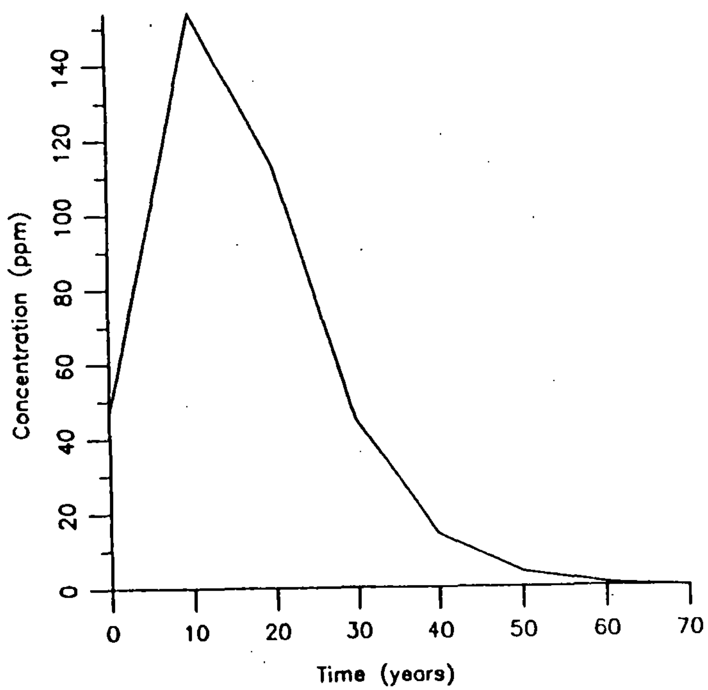


Figure C-5: Time-Dependent Concentration of Methylene Chloride at 55 Feet Downgradient Of the Source

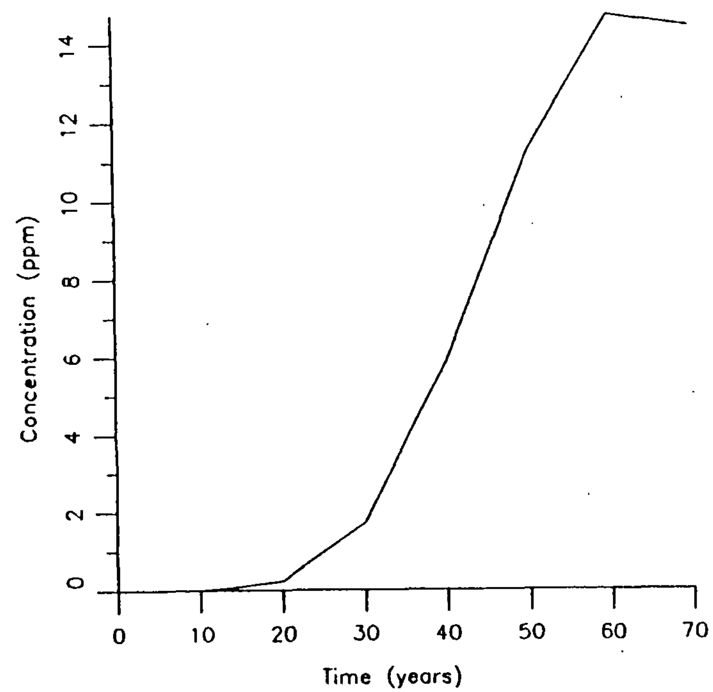


Figure C-6: Time-Dependent Concentration of Methylene Chloride at 2200 Feet Downgradient Of the Source

CONCLUSION

The results generated by the two models are based on limited field data obtained from past site investigations. There is a lack of sufficient field data to adequately define the unsaturated zone. Limited field data from the site was extrapolated to the entire region of the aquifer being modeled. This extrapolation of data resulted in a homogeneous aquifer beyond the cluster of data points (on-site monitoring wells). Model calibration, an important part of modeling, was not performed due to the absence of historical field data and the fact that data points are poorly distributed over the entire region of the aquifer being modeled.

When interpreting the results from the models, one has to keep in mind the limitations of the field data and its use in characterizing the subsurface system. The models cannot predict with sufficient accuracy in the absence of adequate field data needed to properly describe the subsurface system. Furthermore, a model can only approximate and not duplicate a real system. The results, however, can be used to provide a general understanding of the degree and extent of the ground water contamination over a period of time.

REFERENCES

1. Clapp RB, Hornberger GM. 1978. *Empirical Equations for Some Soil Hydraulic Properties.* Water Resources Research. 14:601-604.
2. Enfield CG, Carsel RF, Cohen SZ, Phan T, Walters DM. 1982. *Approximating Pollutant Transport to Ground Water.* Ground Water 20(6) 711-722.
3. Freeze RA, Cherry JA. 1979. *Groundwater.* Englewood Cliffs, NJ: Prentice-Hall, Inc.
4. Gelhar LW, Axness CJ. 1981. *Stochastic Analysis of Macro-Dispersion in 3-Dimensionally Heterogeneous Aquifers.* Report No. H-8. Hydraulic Research Program. New Mexico Institute of Mining and Technology, Soccorro, NM.
5. Harding Lawson Associates. 1987. Remedial Investigation Report. Draft Report prepared for Environmental Protection Agency, Region IX on behalf of Fairchild Semiconductor Corp., Intel Corp., Raytheon Corp.

6. Javandel I, Doughty C, Tsang CF. 1984. *Groundwater Transport: Handbook of Mathematical Models.* Water Resources Monograph 10, AGU; Washington, D.C.

7. Konikow LF, Bredehoeft JD. 1978. *Computer Model for Two-Dimensional Solute Transport and Dispersion in Ground Water.* U.S. Geological Survey Techniques of Water-Resources Investigations, Book 7, Chapter C2.

8. Schultz HL, Palmer WA, Dixon GH, Gleit AF. 1986. *DRAFT Superfund Exposure Assessment Manual.* Submitted to Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington D.C., Versar Inc., Springfield, Virginia.

9. Voss CI. 1984. *SUTRA: A Finite Element Simulation Model for Saturated-Unsaturated Fluid-Density-Dependent Ground-Water Flow with Energy Transport or Chemically-Reactive Single-Species Solute Transport, U.S.G.S.* Water Resources Investigation Report 84-4369.

10. Wahler Associates. November 1987. *Phase II Hydrogeologic Investigation.*

11. Wahler Associates. December 1987. *Aquifer Testing Report.*

12. Wahler Associates. June 1988. *Evaluation of Interim Remedial Alternatives.*

13. Wahler Associates. August 1988. *Soils Characterization Report and Runoff Management Plan.*

SCREENING ANALYSIS FOR AIR EMISSIONS

AIR EMISSIONS RESULTING FROM THE VOLATILIZATION OF INDICATOR CONTAMINANTS IN SOILS

Emission Calculation Methodology

The potential air emissions resulting from the volatilization of carcinogenic organic materials contained in the soil in the rainwater runoff drainage swale are as follows:

Methylene chloride	74.55 lbs
Trichloroethylene	3.25 lbs
1,1-Dichloroethane	1.18 lbs
1,2-Dichloroethane	0.03 lbs
Perchloroethylene	0.35 lbs
1,1-Dichloroethylene	0.08 lbs
Benzene	0.00 lbs
Vinyl Chloride(1)	0.00 lbs
Pentachlorophenol(2)	0.00 lbs

These emissions were obtained by estimating the total quantity of each species contained in the drainage swale area, and assuming that the entire quantity will eventually volatilize. The total contamination was calculated using the boring data presented by Wahler and Associates. The levels of contamination for the 2 deep boring and 8 shallow boring sites that showed detectable quantities of the indicator contaminants, were used to estimate the total contamination. Since the area of significant contamination is centered on a very small volume of soil around the drainage pipe exit, indicator chemicals that were not detected in this area (namely benzene, vinyl chloride, and pentachlorophenol) or elsewhere in the swale are not considered to exist in significant quantities to impact the risk. Each boring site

(1) Vinyl chloride is an extremely volatile chemical (it's boiling point is lower than that of sulfur dioxide), therefore it will evaporate out of rainwater or soil very quickly. Therefore, vinyl chloride is not expected to be present in quantities that could contribute to any long term risk from the contaminated soils and (as expected) was not detected in any of the borings samples from the swale.

(2) Pentachlorophenol, which was not detected in any of the soil borings in the swale, is a solid at ambient soil temperatures (pentachlorophenol has a melting point of 191 degrees Centigrade); therefore no mechanism for pentachlorophenol to contribute to the air inhalation pathway risk from soil contamination exists.

was assigned an applicable area where the level of contamination is assumed to be similar. The determination of these areas takes the other boring sites, contamination levels, and swale topography into account. The levels of contamination for the shallow boring sites is assumed to be confined to soil depths of 2 to 6 feet. Data from the deep boring sites indicated that the contamination of the chemicals in question are not found in soil deeper than six feet except around the drainage pipe "hot spot". For these reasons, the cross-sectional area of contamination in the deeper soil tests for boring locations B-8 and B-9 are assumed to increase beyond a depth of 3-4 feet to account for spreading of the hot spot contamination over a larger area than surface testing indicates. This assumption was used to estimate the deep soil contamination near the hot spot. The assumptions used to calculate the total mass contamination for each of the six chemicals and a sample calculation are presented in Table 1. The calculated mass of each chemical found at the boring sites are presented in Table 2. The detected amounts of each chemical at each applicable boring site are given in Table 3.

TABLE 1
MASS CONTAMINATION CALCULATION ASSUMPTIONS

Boring Location	Applicable Contamination Area (sq ft)	Depth (ft)
SB-1(shallow boring)	56	2-6
SB-2	72	2-6
SB-3	36	2-6
SB-4	36	2-6
SB-5	N/A	N/A
SB-6	N/A	N/A
SB-7	200	2-6
SB-8	N/A	N/A
SB-9	800	2-6
SB-10	200	2-6
SB-11	N/A	N/A
SB-12	200	2-6
SB-13	N/A	N/A
SB-14	N/A	N/A
SB-15	N/A	N/A
B-8(1)(deep boring)	36	2-4
B-8(2)	50	4-8
B-8(3)	50	8-12
B-8(4)	50	2-18
B-8(5)	50	18-22
B-9(1)	36	1-3
B-9(2)	50	3-5
B-9(3)	50	5-9
B-9(4)	50	9-13
B-9(5)	50	13-19
B-9(6)	50	19-22
B-10	N/A	N/A
B-11	N/A	N/A
B-12	N/A	N/A

N/A - designates a site where no contamination of the indicator chemicals were found although for most of these sites organic contamination was found.

SAMPLE CALCULATION

Assumed soil density = 90 lbs/cu ft

For boring B-8(1) - Methylene chloride:

(36 sq ft)(2 ft depth)(90 lbs/sq ft)(3400 parts/1,000,000)

= 22.03 lbs

TABLE 2 – JASCO PLANT RAINWATER RUNOFF SWALE SOIL CONTAMINATION SUMMARY (1)

Boring Site Designation	Boring Site Area Pollutant Contamination (lbs)					
	Methylene Chloride	Trichloro-ethylene	1,1 Dichloro-ethane	Perchloro-ethylene	1,1 Dichloro-ethylene	1,2 Dichloro-ethane
B-8(1)	22.03	3.18	0.17	0.10	0.08	0.03
B-8(2)	43.20	----	0.61	0.12	----	----
B-8(3)	1.28	0.02	0.02	0.01	----	----
B-8(4)	0.24	0.00	0.01	----	----	----
B-8(5)	0.32	----	0.01	----	----	----
B-9(1)	0.06	----	0.00	----	----	----
B-9(2)	0.38	0.01	0.04	0.01	----	----
B-9(3)	0.38	0.03	0.02	0.02	----	----
B-9(4)	0.14	----	0.01	----	----	----
B-9(5)	0.43	----	----	----	----	----
B-9(6)	0.20	----	----	----	----	----
SB-1	0.03	----	0.01	----	----	----
SB-2	0.04	----	0.04	----	----	----
SB-3	2.72	----	----	----	----	----
SB-4	0.83	0.01	0.02	0.01	----	----
SB-7	----	----	0.01	0.01	----	----
SB-9	1.79	----	0.18	0.07	----	----
SB-10	0.43	----	0.03	----	----	----
SB-12	0.05	----	----	----	----	----
Totals	74.55	3.25	1.18	0.35	0.08	0.03

(1) A "----" designates that the chemical was not detected at that sampling location. Benzene, vinyl chloride and pentachlorophenol were not detected in any of the swale soil bore samples.

TABLE 3 - JASCO PLANT RAINWATER RUNOFF SWALE SOIL SAMPLING SUMMARY (1)

Boring Site Designation (2)	Boring Site Contamination Concentration (ppm by weight)					
	Methylene Chloride	Trichloro-ethylene	1,1 Dichloro-ethane	Perchloro-ethylene	1,1 Dichloro-ethylene	1,2 Dichloro-ethane
B-8(1)	3400	490	27	16	13	3.9
B-8(2)	2400	----	34	6.7	----	----
B-8(3)	71	0.85	0.98	0.31	----	----
B-8(4)	8.9	0.088	0.2	----	----	----
B-8(5)	18	----	0.76	----	----	----
B-9(1)	9.3	----	0.16	----	----	----
B-9(2)	42	1.4	2.2	0.87	----	----
B-9(3)	21	1.5	0.68	1.3	----	----
B-9(4)	7.4	----	0.23	----	----	----
B-9(5)	16	----	----	----	----	----
B-9(6)	15	----	----	----	----	----
SB-1	1.3	----	0.54	----	----	----
SB-2	1.7	----	1.4	----	----	----
SB-3	210	----	----	----	----	----
SB-4	64	0.56	1.2	1	----	----
SB-7	----	----	0.16	0.21	----	----
SB-9	6.2	----	0.61	0.24	----	----
SB-10	6	----	0.36	----	----	----
SB-12	0.68	----	----	----	----	----

(1) Concentrations are given as reported in "Soils Characterization Report and Runoff Management Plan" and "Evaluation of Interim Remedial Alternatives" reports prepared by Wahler Associates in August and June of 1988, respectively. A "----" designates that the chemical was not detected at that sampling location. Benzene, vinyl chloride and pentachlorophenol were not detected in any of the swale soil boring samples.

(2) Soil boring site locations B-10, B-11, B-12, SB-5, SB-6, SB-8, SB-11, SB-13, SB-14 and SB-15 are not presented because no detectable amounts of any indicator chemicals were found at those sites.

Air Concentration Estimates

Ambient air concentrations for each contaminant were estimated using the Level 1 Screening Analysis procedure presented in *Air Toxics Source Assessment Manual for California Air Pollution Control Districts* (EPA, 1986). The Level 1 Screening Analysis is a simple, conservative hand calculation used to estimate worst case 1-hour concentrations from non-buoyant sources. The procedure is as follows:

$$Xu / Q = 0.04541\ H^{-1.511}$$

Where,

X = 1-hour concentration (g/m^3)

u = wind speed (m/sec)

Q = emission rate (g/sec)

H = height of release (m)

A release height of H = 1 meter and a wind speed of u = 1 m/sec were assumed. The results were multiplied by 10^6 to obtain ug/m^3 and by an uncertainty factor of 2. This yields

$$\begin{aligned} X &= (0.04541)(Q)(10^6)(2) \\ &= (9.082 \times 10^4)(Q) \end{aligned}$$

where

X = maximum predicted 1-hour concentration (ug/m^3)

Annual average concentrations were derived from the worst case 1-hour estimates by applying a conversion factor of 0.1. This methodology does not distinguish between on-site and off-site receptors; for a ground level release the results would be applicable immediately downwind. The dispersion treatment is quite conservative and would tend to overestimate actual off-site impacts. A summary of emission estimates along with predicted maximum annual concentrations for each contaminant are listed in Table 4.

Health Risk Assessment

The modeling results presented in the previous section were used to evaluate the potential for adverse health effects resulting from volatilization of soil contaminants in the drainage swale area. It was assumed that only the inhalation pathway could result in a significant exposure. Only long-term (chronic) health effects were evaluated.

The theoretical upper-bound estimate of increased lifetime cancer risk was calculated by multiplying the annual average concentration by the appropriate unit risk value. This represents the risk an individual could expect from exposure to the emissions over his or her lifetime (70 years).

A unit risk value is a measure of a substance's carcinogenic potency. The value is defined as the estimated probability of a person contracting cancer as the result of constant exposure to an ambient concentration of 1 ug/m^3 over a 70-year period.

The upper-bound incremental cancer risks for each potential carcinogen at the point of highest concentration are shown in Table 4. The total upper-bound estimate of lifetime risk is calculated by summing the upper-bound estimates for each compound. The total upper-bound incremental lifetime risk at the point of maximum concentration is 5.8×10^{-7}.

Conclusion

The analysis indicates that exposure to air emissions resulting from contaminated soil in the drainage area would not pose a significant chronic health risk to the surrounding residents and worker population. This conclusion is based on the conservative nature of the analysis as evidenced by (1) the assumption that all organics contained in the soil would volatilize as opposed to a portion diffusing downward; (2) the conservative nature of the dispersion methodology used to estimate maximum 1-hour air concentrations; and (3) the use of the 0.1 factor to derive the maximum annual concentration from the 1-hour value as opposed to using historical meteorological data (i.e., San Francisco Airport).

The prime uncertainty of this analysis is the mass emission estimates which were based on maximum historical monitoring data. It is possible that additional

TABLE 4 SUMMARY OF AIR INHALATION RISK ANALYSIS

Compound	70-Year Average Emission Rate (g/sec)	Annual Concentration (ug/m^3)	Unit Risk Factor(1)	Risk(2)
Methylene Chloride	1.53×10^{-5}	0.14	4.1×10^{-6}	5.7×10^{-7}
Trichloroethylene	6.68×10^{-7}	0.006	1.3×10^{-6}	7.8×10^{-9}
1,1 Dichloroethane	2.42×10^{-7}	0.002	---	---
Perchloroethylene	7.20×10^{-8}	0.0007	5.8×10^{-7}	4.1×10^{-10}
1,1-Dichloroethylene	1.65×10^{-8}	0.0001	5.0×10^{-5}	5.0×10^{-9}
1,2 Dichloroethane	6.17×10^{-9}	0.00006	---	---
Benzene(3)	0	0	8.3×10^{-6}	0
Vinyl Chloride(3)	0	0	2.5×10^{-6}	0
Pentachlorophenol(3)	0	0	---	---
TOTAL				5.8 X 10-7

(1) Unit risk factors from Table 3.15 of *Air Toxics Source Assessment Manual for California Air Pollution Control Districts*". Submitted to USEPA Region IX 10/8/86. Prepared by Engineering Science. Unit risk factors for 1,1 dichloroethylene, 1,2 dichloroethane, and benzene are from the Integrated Risk Information System (IRIS) database 1989.

(2) Total Lifetime risk in additional cancer deaths per 1,000,000 effected population is the Annual Concentration times the Unit Risk Factor.

(3) No emissions of these chemicals are assumed to occur from the contaminated soils in the swale.

monitoring could resolve a higher "hot spot" than the present analysis assumed. It is also possible that indicator chemicals may exist in levels below the detection limit throughout the area of the swale. However, it is doubtful that emissions were underestimated to the degree necessary to change the conclusion of this analysis.

ATTACHMENT 1
DISPERSION AND RISK CALCULATIONS[1]

1. Estimate emission rate in g/sec assuming all contaminants volatilize over a 70 year period.[2]

   Methylene chloride

   Q= (74.55 lb)(454g/lb)/[(70yr)(8,760 hr/yr)(3,600 sec/hr)] = 1.53 x 10^{-5} g/sec

   Similarly,

Trichloroethylene	3.25 lb/70 yr = 6.68 x 10^{-7} g/sec
1,1-Dichloroethane	1.18 lb/70 yr = 2.42 x 10^{-7} g/sec
Perchloroethylene	0.35 lb/70 yr = 7.20 x 10^{-8} g/sec
1,1-Dichloroethylene	0.08 lb/70 yr = 1.65 x 10^{-8} g/sec
1,2-Dichloroethane	0.03 lb/70 yr = 6.17 x 10^{-9} g/sec

2. Determine annual average concentration for each contaminant.

   Xann = (9.082 x 10^4)(Q)(0.1)

   Methylene chloride

   Xann = (9.082 x 10^4) (1.53 x 10^{-5})(0.1) = 0.14 ug/m^3

   Similarly,

Trichloroethylene	0.006 ug/m^3
1,1-Dichloroethane	0.002 ug/m^3
Perchloroethylene	0.0007 ug/m^3
1,1-Dichloroethylene	0.0001 ug/m^3
1,2-Dichloroethane	0.00006 ug/m^3

---

(1) No emissions of benzene, vinyl chloride, and pentachlorophenol are assumed to occur from the contaminated soil in the swale.

(2) Assuming that the contaminants volatilize over a shorter time period would not change the risk estimate since the exposure term in the risk calculation would also decrease.

3. Estimate increased lifetime cancer risk by multiplying the average annual concentration by the unit risk value.

Methylene chloride

$$\text{Risk} = (0.14)(4.1 \times 10^{-6}) = 5.7 \times 10^{-7}$$

Trichloroethylene

$$\text{Risk} = (0.006)(1.3 \times 10^{-6}) = 7.8 \times 10^{-9}$$

Perchloroethylene

$$\text{Risk} = (0.0007)(5.0 \times 10^{-7}) = 5.0 \times 10^{-10}$$

1,1-Dichloroethylene

$$\text{Risk} = (0.0001)(5.0 \times 10^{-5}) = 5.0 \times 10^{-9}$$

1,2-Dichloroethane

$$\text{Risk} = (0.00006)(2.6 \times 10^{-5}) = 1.6 \times 10^{-9}$$

No unit risk factor exists for 1,1-Dichloroethane.

$$\text{Total Risk} = 5.8 \times 10^{-7}$$

POTENTIAL CHRONIC AND SUBCHRONIC DAILY INTAKE TABLES

TABLE D-1
POTENTIAL CHRONIC AND SUBCHRONIC DAILY INTAKE
(GROUND WATER INGESTION)
ADULT RESIDENTS

Indicator Contaminant	Chronic (mg/kg/day) Best Estimate(a)	Chronic (mg/kg/day) Maximum Plausible(b)	Subchronic (mg/kg/day) Best Estimate(c)	Subchronic (mg/kg/day) Maximum Plausible(d)
1,2 DCA	4.4×10^{-3}	4.9×10^{-3}	4.4×10^{-3}	4.6×10^{-1}
1,1 DCE	1.4×10^{-3}	1.6×10^{-3}	1.4×10^{-3}	9.4×10^{-2}
TCE	2.5×10^{-2}	2.8×10^{-2}	2.5×10^{-2}	3.5
Vinyl Chloride	8.1×10^{-5}	9.0×10^{-5}	8.1×10^{-5}	2.8×10^{-3}
Benzene	4.9×10^{-4}	5.5×10^{-4}	4.9×10^{-4}	2.1×10^{-2}
Tetrachloroethylene	1.5×10^{-3}	1.7×10^{-3}	1.5×10^{-3}	1.2×10^{-1}
Methylene Chloride	1.8×10^{-1}	2.0×10^{-1}	1.8×10^{-1}	25.0
1,1 DCA	5.2×10^{-3}	5.8×10^{-3}	5.2×10^{-3}	3.8×10^{-1}
PCP	2.1×10^{-4}	2.4×10^{-4}	2.1×10^{-4}	9×10^{-3}

(a) Chronic daily intake (CDI): average concentrations x human intake factor (2.6×10^{-2} mg/kg/day).
(b) CDI: average concentrations x human intake factor (2.9×10^{-2} mg/kg/day).
(c) Subchronic Daily Intake (SDI): average concentration values x human intake factor (2.6×10^{-2} mg/kg/day).
(d) SDI: high concentraton values x human intake factor (2.9×10^{-2} mg/kg/day).

TABLE D-2

POTENTIAL SUBCHRONIC DAILY INTAKE

GROUND WATER INGESTION

CHILDREN

Indicator Contaminant	Subchronic (mg/kg/day) Best Estimate(a)	Maximum Plausible(a)
1,2-DCA	1.0×10^{-2}	9.4×10^{-1}
1,1-DCE	3.2×10^{-3}	1.9×10^{-1}
TCE	5.7×10^{-2}	7.1
Vinyl Chloride	1.8×10^{-4}	5.8×10^{-3}
Benzene	1.1×10^{-3}	4.3×10^{-2}
Tetrachloroethylene	3.4×10^{-3}	2.5×10^{-1}
Methylene Chloride	4.0×10^{-1}	51
1,1-DCA	1.2×10^{-2}	7.6×10^{-1}
PCP	4.8×10^{-4}	1.8×10^{-2}

(a) Subchronic Daily Intake (SDI): average concentration values x human intake factor (5.9×10^{-2} mg/kg/day)

(b) SDI: high concnetration value x human intake factor (5.9×10^{-2} mg/kg/day)

TABLE D-3
POTENTIAL CHRONIC AND SUBCHRONIC DAILY INTAKE
(SOIL INGESTION)
ADULT RESIDENTS

Indicator Contaminant	Chronic (mg/kg/day) Best Estimate(a)	Chronic (mg/kg/day) Maximum Plausible(b)	Subchronic (mg/kg/day) Best Estimate(c)	Subchronic (mg/kg/day) Maximum Plausible(d)
1,2 DCA	8.2×10^{-8}	4.1×10^{-7}	6.7×10^{-8}	4.1×10^{-6}
1,1 DCE	1.8×10^{-7}	9.0×10^{-7}	1.5×10^{-7}	1.5×10^{-5}
TCE	5.3×10^{-6}	2.7×10^{-8}	4.4×10^{-6}	4.9×10^{-4}
Vinyl Chloride	4.1×10^{-8}	2.1×10^{-7}	3.4×10^{-8}	2.1×10^{-7}
Benzene	8.0×10^{-8}	4.0×10^{-6}	6.6×10^{-8}	3.3×10^{-6}
Tetrachloroethylene	1.5×10^{-6}	7.4×10^{-6}	1.2×10^{-6}	6.6×10^{-5}
Methylene Chloride	3.9×10^{-7}	2.0×10^{-4}	3.2×10^{-7}	3.3×10^{-4}
1,1 DCA	9.8×10^{-7}	4.9×10^{-6}	8.1×10^{-7}	6.2×10^{-6}
PCP	8.2×10^{-8}	4.1×10^{-7}	6.7×10^{-8}	1.2×10^{-6}

(a) Chronic daily intake (CDI): average concentrations x human intake factor (8.2×10^{-7} $kg/kg_{bodyweight}/day$).
(b) CDI: average concentrations x human intake factor (4.1×10^{-6} $kg/kg_{bodyweight}/day$).
(c) Subchronic Daily Intake (SDI): average concentration values x human intake factor (8.2×10^{-7} $kg/kg_{bodyweight}/day$).
(d) SDI: high concentraton values x human intake factor (4.1×10^{-6} $kg/kg_{bodyweight}/day$).

TABLE D-4
POTENTIAL SUBCHRONIC DAILY INTAKE
(SOIL INGESTION)
CHILDREN

Indicator Contaminant	Subchronic (mg/kg/day) Best Estimate(a)	Maximum Plausible(b)
1,2 DCA	$8.4 X 10^{-8}$	$6.6 X 10^{-6}$
1,1 DCE	$1.8 X 10^{-7}$	$2.4 X 10^{-5}$
TCE	$5.5 X 10^{-6}$	$8.0 X 10^{-4}$
Vinyl Chloride	$4.2 X 10^{-8}$	$3.4 X 10^{-7}$
Benzene	$8.2 X 10^{-8}$	$5.4 X 10^{-6}$
Tetrachloroethylene	$1.5 X 10^{-6}$	$1.1 X 10^{-4}$
Methylene Chloride	$4.0 X 10^{-7}$	$5.4 X 10^{-4}$
1,1 DCA	$1.0 X 10^{-6}$	$1.0 X 10^{-5}$
PCP	$8.4 X 10^{-8}$	$2.0 X 10^{-6}$

(a) Subchronic Daily Intake (SDI): average concentration values x human intake factor (8.4×10^{-7} $kg/kg_{bodyweight}/day$).

(b) SDI: high concentration values x human intake factor (6.7×10^{-6} $kg/kg_{bodyweight}/day$).

TABLE D-5
POTENTIAL SUBCHRONIC DAILY INTAKE
(SOIL INGESTION)
CONSTRUCTION WORKERS

Indicator Contaminant	Subchronic (mg/kg/day Best Estimate(a)	Maximum Plausible(b)
1,2 DCA	$2.0 X 10^{-7}$	$5.0 X 10^{-6}$
1,1 DCE	$4.4 X 10^{-7}$	$1.8 X 10^{-5}$
TCE	$1.3 X 10^{-5}$	$6.1 X 10^{-4}$
Vinyl Chloride	$1.0 X 10^{-7}$	$2.6 X 10^{-7}$
Benzene	$2.0 X 10^{-7}$	$4.1 X 10^{-6}$
Tetrachloroethylene	$3.6 X 10^{-6}$	$8.2 X 10^{-5}$
Methylene Chloride	$9.6 X 10^{-5}$	$4.1 X 10^{-4}$
1,1 DCA	$2.4 X 10^{-6}$	$7.7 X 10^{-6}$
PCP	$2.0 X 10^{-7}$	$1.5 X 10^{-6}$

(a) Subchronic Daily Intake (SDI): average concentration values x human intake factor (2.0×10^{-6} kg/$kg_{bodyweight}$/day)

(b) SDI: high concentration values x human intake factor (5.1×10^{-6} kg/$kg_{bodyweight}$/day).

TABLE D-6
POTENTIAL CHRONIC AND SUBCHRONIC DAILY INTAKE
(PARTICULATE INHALATION)
ADULT RESIDENTS

Indicator Contaminant	Chronic (mg/kg/day) Best Estimate(a)	Chronic (mg/kg/day) Maximum Plausible(b)	Subchronic (mg/kg/day) Best Estimate(c)	Subchronic (mg/kg/day) Maximum Plausible(d)
1,2 DCA	6.2×10^{-10}	1.6×10^{-9}	1.2×10^{-9}	3.2×10^{-8}
1,1 DCE	1.4×10^{-9}	3.5×10^{-9}	2.2×10^{-8}	1.2×10^{-7}
TCE	4.0×10^{-8}	1.0×10^{-7}	7.8×10^{-8}	3.8×10^{-6}
Vinyl Chloride	3.1×10^{-10}	8.0×10^{-9}	6.0×10^{-10}	1.6×10^{-9}
Benzene	6.1×10^{-10}	1.6×10^{-9}	1.2×10^{-9}	2.6×10^{-8}
Tetrachloroethylene	1.1×10^{-8}	2.9×10^{-8}	2.2×10^{-8}	5.1×10^{-7}
Methylene Chloride	3.0×10^{-7}	7.7×10^{-7}	5.8×10^{-7}	2.6×10^{-6}
1,1 DCA	7.4×10^{-9}	1.9×10^{-8}	1.4×10^{-8}	4.8×10^{-8}
PCP	6.2×10^{-10}	1.6×10^{-9}	1.2×10^{-9}	9.6×10^{-9}

(a) Chronic daily intake (CDI): average concentrations x human intake factor (6.2×10^{-9} $kg/kg_{bodyweight}/day$).
(b) CDI: average concentrations x human intake factor (1.6×10^{-8} $kg/kg_{bodyweight}/day$).
(c) Subchronic Daily Intake (SDI): average concentration values x human intake factor (1.2×10^{-8} $kg/kg_{bodyweight}/day$).
(d) SDI: high concentraton values x human intake factor (3.2×10^{-8} $kg/kg_{bodyweight}/day$).

TABLE D-7
POTENTIAL SUBCHRONIC DAILY INTAKE
(PARTICULATE INHALATION)
CHILDREN

	Subchronic (mg/kg/day	
Indicator Contaminant	Best Estimate(a)	Maximum Plausible(b)
1,2 DCA	4.7×10^{-9}	2.0×10^{-7}
1,1 DCE	1.0×10^{-8}	7.2×10^{-7}
TCE	3.1×10^{-7}	2.4×10^{-5}
Vinyl Chloride	2.4×10^{-9}	1.0×10^{-8}
Benzene	4.6×10^{-9}	1.6×10^{-7}
Tetrachloroethylene	8.5×10^{-8}	3.2×10^{-6}
Methylene Chloride	2.3×10^{-6}	1.6×10^{-5}
1,1 DCA	5.6×10^{-8}	3.0×10^{-7}
PCP	4.7×10^{-9}	6.0×10^{-8}

(a) Subchronic Daily Intake (SDI): average concentration values x human intake factor (4.7×10^{-8} $kg/kg_{bodyweight}/day$)
(b) SDI: high concentration values x human intake factor (2.0×10^{-7} $kg/kg_{bodyweight}/day$).

TABLE D-8
POTENTIAL SUBCHRONIC DAILY INTAKE
(PARTICULATE INHALATION)
CONSTRUCTION WORKERS

Indicator Contaminant	Subchronic (mg/kg/day) Best Estimate(a)	Maximum Plausible(b)
1,2 DCA	3.1×10^{-9}	4.0×10^{-8}
1,1 DCE	6.8×10^{-9}	1.4×10^{-7}
TCE	2.0×10^{-7}	4.8×10^{-6}
Vinyl Chloride	1.6×10^{-9}	2.0×10^{-9}
Benzene	3.0×10^{-9}	3.2×10^{-8}
Tetrachloroethylene	5.6×10^{-8}	6.4×10^{-7}
Methylene Chloride	1.5×10^{-6}	3.2×10^{-6}
1,1 DCA	3.7×10^{-8}	6.0×10^{-8}
PCP	3.1×10^{-9}	1.2×10^{-8}

(a) Subchronic Daily Intake (SDI): average concentration values x human intake factor (3.1×10^{-8} $kg/kg_{bodyweight}$/day)
(b) SDI: high concentration values x human intake factor (4.0×10^{-8} $kg/kg_{bodyweight}$/day).

TABLE D-9
POTENTIAL CHRONIC AND SUBCHRONIC DAILY INTAKE
(INHALATION OF VAPORS WHILE SHOWERING)
ADULT RESIDENTS

Indicator Contaminant	Chronic (mg/kg/day) Best Estimate(a)	Chronic (mg/kg/day) Maximum Plausible(b)	Subchronic (mg/kg/day) Best Estimate(c)	Subchronic (mg/kg/day) Maximum Plausible(d)
1,2 DCA	2.2×10^{-4}	5.3×10^{-4}	2.0×10^{-2}	4.9×10^{-2}
1,1 DCE	7.0×10^{-5}	1.7×10^{-4}	4.3×10^{-3}	1.0×10^{-2}
TCE	1.3×10^{-3}	3.0×10^{-3}	1.7×10^{-1}	3.7×10^{-1}
Vinyl Chloride	4.0×10^{-6}	1.0×10^{-5}	1.3×10^{-4}	3.0×10^{-4}
Benzene	2.0×10^{-5}	6.0×10^{-5}	9.5×10^{-4}	2.3×10^{-3}
Tetrachloroethylene	8.0×10^{-5}	1.8×10^{-4}	5.6×10^{-3}	1.3×10^{-2}
Methylene Chloride	8.8×10^{-3}	2.1×10^{-2}	1.1	2.7
1,1 DCA	2.6×10^{-4}	6.2×10^{-4}	1.7×10^{-2}	4.0×10^{-2}
PCP	1.1×10^{-5}	2.5×10^{-5}	4.0×10^{-4}	9.6×10^{-4}

(a) Chronic daily intake (CDI): average concentrations x human intake factor (1.3×10^{-3} m^3/kg/day).
(b) CDI: average concentrations x human intake factor (3.1×10^{-3} m^3/kg/day).
(c) Subchronic Daily Intake (SDI): high concentration values x human intake factor (1.3×10^{-3} m^3/kg/day).
(d) SDI: high concentraton values x human intake factor (3.1×10^{-3} m^3/kg/day).

HAZARD INDICES AND POTENTIAL CANCER RISK TABLES

TABLE E-1
COMPARISON OF CHRONIC DAILY INTAKE (CDI) OF NON-CARCINOGENS
WITH ACCEPTABLE CHRONIC DAILY INTAKE (AIC)
GROUND WATER INGESTION
(ADULT RESIDENT)

Indicator Contaminant	AIC (mg/kg/day)	CDI (mg/kg/day) Best Estimate	CDI (mg/kg/day) Maximum Plausible	CDI:AIC (mg/kg/day) Best Estimate	CDI:AIC (mg/kg/day) Maximum Plausible
1,2 DCA	---	4.4×10^{-3}	4.9×10^{-3}	---	---
1,1 DCE	9.0×10^{-3}	1.4×10^{-3}	1.6×10^{-3}	1.6×10^{-1}	1.8×10^{-1}
TCE	---	2.5×10^{-2}	2.8×10^{-2}	---	---
Vinyl Chloride	---	8.1×10^{-5}	9.0×10^{-5}	---	---
Benzene	---	4.9×10^{-4}	5.5×10^{-4}	---	---
Tetrachloroethylene	1.0×10^{-2}	1.5×10^{-3}	1.7×10^{-4}	1.5×10^{-3}	1.7×10^{-1}
Methylene Chloride	6.00×10^{-2}	1.8×10^{-1}	2.0×10^{-1}	3.0	3.3
1,1 DCA	1.0×10^{-1}	5.2×10^{-3}	5.8×10^{-3}	5.2×10^{-2}	5.8×10^{-2}
PCP	3.0×10^{-2}	2.1×10^{-4}	2.4×10^{-4}	7.0×10^{-3}	8.0×10^{-3}
Total				3.2	3.7

TABLE E-2
COMPARISON OF SUBCHRONIC DAILY INTAKE (SDI) OF NON-CARCINOGENS
WITH ACCEPTABLE SUBCHRONIC DAILY INTAKE (AIS)
GROUND WATER INGESTION
(ADULT RESIDENT)

Indicator Contaminant	AIS (mg/kg/day)	SDI (mg/kg/day) Best Estimate	SDI (mg/kg/day) Maximum Plausible	SDI:AIS (mg/kg/day) Best Estimate	SDI:AIS (mg/kg/day) Maximum Plausible
1,2 DCA	---	4.4×10^{-3}	4.6×10^{-1}	---	---
1,1 DCE	9.0×10^{-3}	1.4×10^{-3}	9.4×10^{-2}	1.6×10^{-1}	1.1×10^{1}
TCE	---	2.5×10^{-2}	3.5	---	---
Vinyl Chloride	---	8.1×10^{-5}	2.8×10^{-3}	---	---
Benzene	---	4.9×10^{-4}	2.1×10^{-2}	---	---
Tetrachloroethylene	1.0×10^{-2}	1.5×10^{-3}	1.3×10^{-1}	1.5×10^{-1}	1.3×10^{1}
Methylene Chloride	6.0×10^{-2}	1.8×10^{-1}	25	3.0	4.2×10^{2}
1,1 DCA	1.0	5.2×10^{-3}	3.8×10^{-1}	5.2×10^{-3}	3.8×10^{-1}
PCP	3.0×10^{-2}	2.1×10^{-4}	9.0×10^{-3}	7.0×10^{-3}	3.0×10^{-1}
Total				3.3	440

TABLE E-3
COMPARISON OF SUBCHRONIC DAILY INTAKE (SDI) OF NON-CARCINOGENS
WITH ACCEPTABLE SUBCHRONIC DAILY INTAKE (AIS)
GROUND WATER INGESTION
(CHILDREN)

Indicator Contaminant	AIS (mg/kg/day)	SDI (mg/kg/day) Best Estimate	SDI (mg/kg/day) Maximum Plausible	SDI:AIS (mg/kg/day) Best Estimate	SDI:AIS (mg/kg/day) Maximum Plausible
1,2 DCA	---	1.0×10^{-2}	9.4×10^{-1}	---	---
1,1 DCE	9.0×10^{-3}	3.3×10^{-3}	1.9×10^{-1}	3.6×10^{-1}	2.1×10^{1}
TCE	---	5.7×10^{-2}	7.1	---	---
Vinyl Chloride	---	1.8×10^{-4}	5.8×10^{-3}	---	---
Benzene	---	1.1×10^{-3}	4.3×10^{-2}	---	---
Tetrachloroethylene	1.0×10^{-2}	3.4×10^{-3}	2.5×10^{-1}	3.4×10^{-1}	2.5×10^{1}
Methylene Chloride	6.0×10^{-2}	4.0×10^{-1}	51	6.7	850
1,1 DCA	1.0	1.2×10^{-2}	7.6×10^{-1}	1.2×10^{-2}	7.6×10^{-1}
PCP	3.0×10^{-2}	4.8×10^{-4}	1.8×10^{-2}	1.6×10^{-2}	6.0×10^{-1}
Total				8.0	896

TABLE E-4
COMPARISON OF CHRONIC DAILY INTAKE (CDI) OF NON-CARCINOGENS
WITH ACCEPTABLE CHRONIC DAILY INTAKE (AIC)
INHALATION OF VAPORS WHILE SHOWERING
(ADULT RESIDENT)

	AIC (mg/kg/day)	CDI (mg/kg/day)		CDI:AIC (mg/kg/day)	
Indicator Contaminant		Best Estimate	Maximum Plausible	Best Estimate	Maximum Plausible
1,2 DCA	---	2.2×10^{-4}	5.3×10^{-4}	---	---
1,1 DCE	---	7.0×10^{-5}	1.7×10^{-4}	---	---
TCE	---	1.3×10^{-3}	3.0×10^{-3}	---	---
Vinyl Chloride	---	4.0×10^{-6}	1.0×10^{-5}	---	---
Benzene	---	2.0×10^{-5}	6.0×10^{-5}	---	---
Tetrachloroethylene	---	8.0×10^{-5}	1.8×10^{-4}	---	---
Methylene Chloride	9.0×10^{-1}	8.8×10^{-3}	2.1×10^{-2}	9.8×10^{-3}	2.3×10^{-2}
1,1 DCA	1.0×10^{-1}	2.6×10^{-4}	6.2×10^{-4}	2.6×10^{-3}	6.2×10^{-3}
PCP	---	1.1×10^{-5}	2.5×10^{-5}	---	---
Total				1.2×10^{-2}	2.9×10^{-2}

TABLE E-5
COMPARISON OF SUBCHRONIC DAILY INTAKE (SDI) OF NON-CARCINOGENS WITH ACCEPTABLE SUBCHRONIC DAILY INTAKE (AIS) INHALATION OF VAPORS WHILE SHOWERING (ADULT RESIDENT)

Indicator Contaminant	AIS (mg/kg/day)	SDI (mg/kg/day) Best Estimate	SDI (mg/kg/day) Maximum Plausible	SDI:AIS (mg/kg/day) Best Estimate	SDI:AIS (mg/kg/day) Maximum Plausible
1,2 DCA	---	2.0×10^{-2}	4.9×10^{-2}	---	---
1,1 DCE	---	4.3×10^{-3}	1.0×10^{-2}	---	---
TCE	---	1.7×10^{-1}	3.7×10^{-4}	---	---
Vinyl Chloride	---	1.3×10^{-4}	3.0×10^{-4}	---	---
Benzene	---	9.5×10^{-4}	2.3×10^{-3}	---	---
Tetrachloroethylene	---	5.6×10^{-3}	1.3×10^{-2}	---	---
Methylene Chloride	9.0×10^{-1}	1.1	2.7	1.2	3.0
1,1 DCA	1.0	1.7×10^{-2}	4.0×10^{-2}	1.7×10^{-2}	4.0×10^{-2}
PCP	---	4.0×10^{-4}	9.6×10^{-4}	---	---
Total				1.2	3.0

TABLE E-6
CALCULATION OF LIFETIME CANCER RISK
GROUND WATER INGESTION
(ADULT RESIDENT)

	CDI (mg/kg/day)		Carcinogenic Potency Factor $(mg/kg/day)^{-1}$	Lifetime Cancer Risk	
Indicator Contaminant	**Best Estimate**	**Maximum Plausible**		**Best Estimate**	**Maximum Plausible**
1,2 DCA	4.4×10^{-3}	4.9×10^{-3}	9.10×10^{-2}	4.0×10^{-4}	4.5×10^{-4}
1,1 DCE	1.4×10^{-3}	1.6×10^{-3}	6.0×10^{-1}	8.4×10^{-4}	9.6×10^{-4}
TCE	2.5×10^{-2}	2.8×10^{-2}	1.10×10^{-2}	2.8×10^{-4}	3.1×10^{-4}
Vinyl Chloride	8.1×10^{-5}	9.0×10^{-5}	2.30	1.9×10^{-4}	2.07×10^{-4}
Benzene	4.9×10^{-4}	5.5×10^{-4}	2.9×10^{-2}	1.4×10^{-5}	1.6×10^{-5}
Tetrachloroethylene	1.5×10^{-3}	1.7×10^{-4}	5.10×10^{-2}	7.7×10^{-5}	8.6×10^{-6}
Methylene Chloride	1.8×10^{-1}	2.0×10^{-1}	7.50×10^{-3}	1.4×10^{-3}	1.5×10^{-3}
1,1 DCA	5.2×10^{-3}	5.8×10^{-3}	9.1×10^{-2}	4.7×10^{-4}	5.3×10^{-4}
PCP	2.1×10^{-4}	9.0×10^{-3}	1.6×10^{-2}	3.4×10^{-6}	3.8×10^{-6}
Total				3.6×10^{-3}	4.0×10^{-3}

(1) Chronic Daily Intake.

TABLE E-7
CALCULATION OF LIFETIME CANCER RISK
INHALATION OF VAPORS WHILE SHOWERING
(ADULT RESIDENT)

	CDI(1) (mg/kg/day)		Carcinogenic Potency Factor $(mg/kg/day)^{-1}$	Lifetime Cancer Risk	
Indicator Contaminant	Best Estimate	Maximum Plausible		Best Estimate	Maximum Plausible
1,2 DCA	2.2×10^{-4}	5.3×10^{-4}	9.1×10^{-2}	2.0×10^{-5}	4.8×10^{-5}
1,1 DCE	7.0×10^{-5}	1.7×10^{-4}	1.2	8.4×10^{-5}	2.0×10^{-4}
TCE	1.3×10^{-3}	3.0×10^{-3}	1.3×10^{-2}	1.7×10^{-5}	3.9×10^{-5}
Vinyl Chloride	4.0×10^{-6}	1.0×10^{-5}	3.0×10^{-1}	1.2×10^{-6}	3.0×10^{-6}
Benzene	2.0×10^{-5}	6.0×10^{-5}	2.9×10^{-2}	5.8×10^{-7}	1.7×10^{-6}
Tetrachloroethylene	8.0×10^{-5}	1.8×10^{-4}	3.3×10^{-3}	2.6×10^{-7}	5.9×10^{-7}
Methylene Chloride	8.8×10^{-3}	2.1×10^{-2}	1.4×10^{-2}	1.2×10^{-4}	2.9×10^{-4}
1,1 DCA	2.6×10^{-4}	6.2×10^{-4}	9.1×10^{-2}	2.4×10^{-5}	5.6×10^{-5}
PCP	1.1×10^{-5}	2.5×10^{-5}	---	---	---
Total				2.7×10^{-4}	5.9×10^{-4}

(1) Chronic Daily Intake.

TABLE E-8
COMPARISON OF CHRONIC DAILY INTAKE (CDI) OF NON-CARCINOGENS
WITH ACCEPTABLE CHRONIC DAILY INTAKE (AIC)
SOIL INGESTION
(ADULT RESIDENT)

Indicator Contaminant	AIC (mg/kg/day)	CDI (mg/kg/day) Best Estimate	CDI (mg/kg/day) Maximum Plausible	CDI:AIC (mg/kg/day) Best Estimate	CDI:AIC (mg/kg/day) Maximum Plausible
1,2 DCA	---	8.2×10^{-8}	4.1×10^{-7}	---	---
1,1 DCE	9.0×10^{-3}	1.8×10^{-7}	9.0×10^{-7}	2.0×10^{-5}	1.0×10^{-4}
TCE	---	5.3×10^{-6}	2.7×10^{-5}	---	---
Vinyl Chloride	---	4.1×10^{-8}	2.1×10^{-7}	---	---
Benzene	---	8.0×10^{-8}	4.0×10^{-7}	---	---
Tetrachloroethylene	1.0×10^{-2}	1.5×10^{-6}	7.4×10^{-6}	1.5×10^{-4}	7.4×10^{-4}
Methylene Chloride	6.0×10^{-2}	3.9×10^{-7}	2.0×10^{-4}	6.6×10^{-6}	3.3×10^{-3}
1,1 DCA	1.0×10^{-1}	9.8×10^{-7}	4.9×10^{-6}	9.8×10^{-6}	4.9×10^{-5}
PCP	3.0×10^{-2}	8.2×10^{-8}	4.1×10^{-7}	2.7×10^{-6}	1.4×10^{-5}
Total				8.4×10^{-4}	4.2×10^{-3}

TABLE E-9
COMPARISON OF SUBCHRONIC DAILY INTAKE (SDI) OF NON-CARCINOGENS
WITH ACCEPTABLE SUBCHRONIC DAILY INTAKE (AIS)
SOIL INGESTION
(ADULT RESIDENTS)

Indicator Contaminant	AIS (mg/kg/day)	SDI (mg/kg/day) Best Estimate	SDI (mg/kg/day) Maximum Plausible	SDI:AIS (mg/kg/day) Best Estimate	SDI:AIS (mg/kg/day) Maximum Plausible
1,2 DCA	---	6.7×10^{-8}	4.1×10^{-6}	---	---
1,1 DCE	9.0×10^{-3}	1.5×10^{-7}	1.5×10^{-5}	1.7×10^{-5}	1.7×10^{-3}
TCE	---	4.4×10^{-6}	4.9×10^{-4}	---	---
Vinyl Chloride	---	3.4×10^{-8}	2.1×10^{-7}	---	---
Benzene	---	6.6×10^{-8}	3.3×10^{-6}	---	---
Tetrachloroethylene	1.0×10^{-2}	1.2×10^{-6}	6.6×10^{-5}	1.2×10^{-4}	6.6×10^{-3}
Methylene Chloride	6.0×10^{-2}	3.2×10^{-7}	3.3×10^{-4}	5.3×10^{-6}	5.5×10^{-3}
1,1 DCA	1.00	8.1×10^{-7}	6.2×10^{-6}	8.9×10^{-8}	4.6×10^{-7}
PCP	3.0×10^{-2}	6.7×10^{-8}	1.2×10^{-6}	2.2×10^{-6}	4.0×10^{-5}
Total				1.4×10^{-4}	1.4×10^{-2}

TABLE E-10
COMPARISON OF SUBCHRONIC DAILY INTAKE (SDI) OF NON-CARCINOGENS
WITH ACCEPTABLE SUBCHRONIC DAILY INTAKE (AIS)
SOIL INGESTION
(CHILDREN)

Indicator Contaminant	AIS (mg/kg/day)	SDI (mg/kg/day) Best Estimate	SDI (mg/kg/day) Maximum Plausible	SDI:AIS (mg/kg/day) Best Estimate	SDI:AIS (mg/kg/day) Maximum Plausible
1,2 DCA	---	8.4×10^{-8}	6.6×10^{-6}	---	---
1,1 DCE	9.0×10^{-3}	1.8×10^{-7}	2.4×10^{-5}	2.0×10^{-5}	2.7×10^{-3}
TCE	---	5.5×10^{-6}	8.0×10^{-4}	---	---
Vinyl Chloride	---	4.2×10^{-8}	3.4×10^{-7}	---	---
Benzene	---	8.2×10^{-8}	5.4×10^{-6}	---	---
Tetrachloroethylene	1.0×10^{-2}	1.5×10^{-6}	1.1×10^{-4}	1.5×10^{-4}	1.1×10^{-2}
Methylene Chloride	6.0×10^{-2}	4.0×10^{-7}	5.4×10^{-4}	6.7×10^{-6}	9.0×10^{-3}
1,1 DCA	1.0	1.0×10^{-6}	1.0×10^{-5}	1.0×10^{-6}	1.0×10^{-5}
PCP	3.0×10^{-2}	8.4×10^{-8}	2.0×10^{-6}	2.8×10^{-6}	6.7×10^{-5}
Total				1.8×10^{-4}	2.3×10^{-2}

TABLE E-11
COMPARISON OF SUBCHRONIC DAILY INTAKE (SDI) OF NON-CARCINOGENS
WITH ACCEPTABLE SUBCHRONIC DAILY INTAKE (AIS)
SOIL INGESTION
(CONSTRUCTION WORKER)

Indicator Contaminant	AIS (mg/kg/day)	SDI (mg/kg/day) Best Estimate	SDI (mg/kg/day) Maximum Plausible	SDI:AIS (mg/kg/day) Best Estimate	SDI:AIS (mg/kg/day) Maximum Plausible
1,2 DCA	---	2.0×10^{-7}	5.0×10^{-6}	---	---
1,1 DCE	9.0×10^{-3}	4.4×10^{-7}	1.8×10^{-5}	4.9×10^{-5}	2.0×10^{-3}
TCE	---	1.3×10^{-5}	6.1×10^{-4}	---	---
Vinyl Chloride	---	1.0×10^{-7}	2.6×10^{-7}	---	---
Benzene	---	2.0×10^{-7}	4.1×10^{-6}	---	---
Tetrachloroethylene	1.0×10^{-2}	3.6×10^{-6}	8.2×10^{-5}	3.6×10^{-4}	8.2×10^{-3}
Methylene Chloride	6.0×10^{-2}	9.6×10^{-5}	4.1×10^{-4}	1.6×10^{-3}	6.8×10^{-3}
1,1 DCA	1.0	2.4×10^{-6}	7.7×10^{-6}	2.4×10^{-6}	7.7×10^{-6}
PCP	3.0×10^{-2}	2.0×10^{-7}	1.53×10^{-6}	4.0×10^{-8}	3.2×10^{-7}
Total				2.0×10^{-3}	1.7×10^{-2}

TABLE E-12
CALCULATION OF LIFETIME CANCER RISK
SOIL INGESTION
(ADULT RESIDENT)

	CDI(1) (mg/kg/day)		Carcinogenic Potency Factor $(mg/kg/day)^{-1}$	Lifetime Cancer Risk	
Indicator Contaminant	Best Estimate	Maximum Plausible		Best Estimate	Maximum Plausible
1,2 DCA	8.2×10^{-8}	4.1×10^{-7}	9.10×10^{-2}	7.5×10^{-9}	3.7×10^{-8}
1,1 DCE	1.8×10^{-7}	9.0×10^{-7}	6.0×10^{-1}	1.1×10^{-7}	5.4×10^{-7}
TCE	5.3×10^{-6}	2.7×10^{-5}	1.10×10^{-2}	5.9×10^{-8}	2.9×10^{-7}
Vinyl Chloride	4.1×10^{-8}	2.1×10^{-7}	2.30	9.4×10^{-8}	4.7×10^{-7}
Benzene	8.0×10^{-8}	4.0×10^{-7}	2.9×10^{-2}	2.3×10^{-9}	1.2×10^{-8}
Tetrachloroethylene	1.5×10^{-6}	7.4×10^{-6}	5.10×10^{-2}	7.5×10^{-8}	3.8×10^{-7}
Methylene Chloride	3.9×10^{-5}	2.0×10^{-4}	7.5×10^{-3}	3.0×10^{-7}	1.5×10^{-6}
1,1 DCA	9.8×10^{-7}	4.9×10^{-6}	9.1×10^{-2}	9.0×10^{-9}	4.5×10^{-7}
PCP	8.2×10^{-8}	4.1×10^{-7}	1.6×10^{-2}	1.3×10^{-9}	4.5×10^{-7}
Total				7.3×10^{-7}	3.7×10^{-6}

(1) Chronic Daily Intake.

TABLE E-13
COMPARISON OF CHRONIC DAILY INTAKE (CDI) OF NON-CARCINOGENS
WITH ACCEPTABLE CHRONIC DAILY INTAKE (AIC)
PARTICULATE INHALATION
(ADULT RESIDENT)

Indicator Contaminant	AIC (mg/kg/day)	CDI (mg/kg/day) Best Estimate	CDI (mg/kg/day) Maximum Plausible	CDI:AIC (mg/kg/day) Best Estimate	CDI:AIC (mg/kg/day) Maximum Plausible
1,2 DCA	---	6.2×10^{-10}	1.6×10^{-9}	---	---
1,1 DCE	---	1.4×10^{-9}	3.5×10^{-9}	---	---
TCE	---	4.0×10^{-8}	1.0×10^{-7}	---	---
Vinyl Chloride	---	3.1×10^{-10}	8.0×10^{-10}	---	---
Benzene	---	6.1×10^{-10}	1.6×10^{-9}	---	---
Tetrachloroethylene	---	1.1×10^{-8}	2.9×10^{-8}	---	---
Methylene Chloride	9.0×10^{-1}	3.0×10^{-7}	7.7×10^{-7}	3.3×10^{-7}	8.6×10^{-7}
1,1 DCA	1.0×10^{-1}	7.4×10^{-9}	1.9×10^{-8}	7.4×10^{-8}	1.9×10^{-7}
PCP	---	6.2×10^{-10}	1.6×10^{-9}	---	---
Total				4.0×10^{-7}	1.1×10^{-6}

TABLE E-14
COMPARISON OF SUBCHRONIC DAILY INTAKE (SDI) OF NON-CARCINOGENS WITH ACCEPTABLE SUBCHRONIC DAILY INTAKE (AIS)
PARTICULATE INHALATION
(ADULT RESIDENT)

Indicator Contaminant	AIS (mg/kg/day)	SDI (mg/kg/day) Best Estimate	SDI (mg/kg/day) Maximum Plausible	SDI:AIS (mg/kg/day) Best Estimate	SDI:AIS (mg/kg/day) Maximum Plausible
1,2 DCA	---	1.2×10^{-9}	3.2×10^{-8}	---	---
1,1 DCE	---	2.6×10^{-9}	1.2×10^{-7}	---	---
TCE	---	7.8×10^{-8}	3.8×10^{-6}	---	---
Vinyl Chloride	---	6.0×10^{-10}	1.6×10^{-9}	---	---
Benzene	---	1.2×10^{-9}	2.6×10^{-8}	---	---
Tetrachloroethylene	---	2.2×10^{-8}	5.1×10^{-8}	---	---
Methylene Chloride	9.0×10^{-1}	5.8×10^{-7}	2.6×10^{-6}	6.4×10^{-7}	2.9×10^{-6}
1,1 DCA	1.0	1.4×10^{-8}	4.8×10^{-8}	1.4×10^{-8}	4.8×10^{-8}
PCP	---	1.2×10^{-9}	9.6×10^{-9}	---	---
Total				6.5×10^{-7}	2.9×10^{-6}

TABLE E-15
COMPARISON OF SUBCHRONIC DAILY INTAKE (SDI) OF NON-CARCINOGENS
WITH ACCEPTABLE SUBCHRONIC DAILY INTAKE (AIS)
PARTICULATE INHALATION
(CHILDREN)

Indicator Contaminant	AIS (mg/kg/day)	SDI (mg/kg/day) Best Estimate	SDI (mg/kg/day) Maximum Plausible	SDI:AIS (mg/kg/day) Best Estimate	SDI:AIS (mg/kg/day) Maximum Plausible
1,2 DCA	---	4.7×10^{-9}	2.0×10^{-7}	---	---
1,1 DCE	---	1.0×10^{-8}	7.2×10^{-7}	---	---
TCE	---	3.1×10^{-7}	2.4×10^{-5}	---	---
Vinyl Chloride	---	2.4×10^{-9}	1.0×10^{-8}	---	---
Benzene	---	4.6×10^{-9}	1.6×10^{-7}	---	---
Tetrachloroethylene	---	8.5×10^{-8}	1.6×10^{-5}	---	---
Methylene Chloride	9.0×10^{-1}	2.3×10^{-6}	1.6×10^{-5}	2.6×10^{-6}	1.8×10^{5}
1,1 DCA	1.0	5.1×10^{-8}	3.0×10^{-7}	5.1×10^{-8}	3.0×10^{-7}
PCP	---	4.7×10^{-9}	6.0×10^{-8}	---	---
Total				2.6×10^{-6}	1.8×10^{-5}

TABLE E-16
COMPARISON OF SUBCHRONIC DAILY INTAKE (SDI) OF NON-CARCINOGENS
WITH ACCEPTABLE SUBCHRONIC DAILY INTAKE (AIS)
PARTICULATE INHALATION
(CONSTRUCTION WORKERS)

Indicator Contaminant	AIS (mg/kg/day)	SDI (mg/kg/day) Best Estimate	SDI (mg/kg/day) Maximum Plausible	SDI:AIS (mg/kg/day) Best Estimate	SDI:AIS (mg/kg/day) Maximum Plausible
1,2 DCA	---	3.1×10^{-9}	4.0×10^{-8}	---	---
1,1 DCE	---	6.8×10^{-9}	1.4×10^{-7}	---	---
TCE	---	2.0×10^{-7}	4.8×10^{-6}	---	---
Vinyl Chloride	---	1.6×10^{-9}	2.0×10^{-9}	---	---
Benzene	---	3.0×10^{-9}	3.2×10^{-8}	---	---
Tetrachloroethylene	---	5.6×10^{-8}	6.4×10^{-7}	---	---
Methylene Chloride	9.0×10^{-1}	1.5×10^{-6}	3.2×10^{-6}	1.7×10^{-6}	3.6×10^{-6}
1,1 DCA	1.0	3.7×10^{-8}	6.0×10^{-8}	3.7×10^{-8}	6.0×10^{-8}
PCP	---	3.1×10^{-9}	1.2×10^{-8}		
Total				1.7×10^{-6}	3.6×10^{-6}

TABLE E-17
CALCULATION OF LIFETIME CANCER RISK
PARTICULATE INHALATION
(ADULT RESIDENT)

	CDI(1) (mg/kg/day)		Carcinogenic Potency Factor $(mg/kg/day)^{-1}$	Lifetime Cancer Risk	
Indicator Contaminant	Best Estimate	Maximum Plausible		Best Estimate	Maximum Plausible
1,2-DCA	6.2×10^{-10}	1.6×10^{-9}	9.1×10^{-2}	5.6×10^{-11}	1.5×10^{-10}
1,1-DCE	1.4×10^{-9}	3.5×10^{-9}	1.2	1.6×10^{-9}	4.2×10^{-9}
TCE	4.0×10^{-8}	1.0×10^{-7}	1.3×10^{-2}	5.2×10^{-10}	1.4×10^{-9}
Vinyl Chloride	3.1×10^{-10}	8.0×10^{-10}	3.0×10^{-1}	9.3×10^{-11}	2.4×10^{-10}
Benzene	6.1×10^{-10}	1.6×10^{-9}	2.9×10^{-2}	1.8×10^{-11}	4.6×10^{-11}
Tetrachloroethylene	1.1×10^{-8}	2.9×10^{-8}	3.3×10^{-3}	3.7×10^{-11}	9.5×10^{-11}
Methylene Chloride	3.0×10^{-7}	7.7×10^{-7}	1.4×10^{-2}	4.2×10^{-9}	1.1×10^{-8}
1,1 DCA	7.4×10^{-9}	1.9×10^{-8}	---	---	---
PCP	6.2×10^{-10}	1.6×10^{-9}	---	---	---
Total				6.5×10^{-9}	1.7×10^{-8}

(1) Chronic Daily Intake.

TABLE E-18
COMPARISON OF SUBCHRONIC DAILY INTAKE (SDI) AND CHRONIC DAILY INTAKE (CDI)
OF NON-CARCINOGENS WITH ACCEPTABLE SUBCHRONIC DAILY INTAKE (AIS)
AND ACCEPTABLE CHRONIC DAILY INTAKE (AIC)
(ADULT RESIDENT)
TOTAL DAILY INTAKE BY INGESTION(1)

Indicator Contaminant	AIS (mg/kg/day)	SDI(mg/kg/day) (mg/kg/day) Best Estimate	Maximum Plausible	SDI:AIS (mg/kg/day) Best Estimate	Maximum Plausible	AIC (mg/kg/day)	CDI (mg/kg/day) Best Estimate	Maximum Plausible	CDI:AIC Best Estimate	Maximum Plausible
1,2 DCA	---	4.4×10^{-3}	4.6×10^{-1}	---	---	---	4.4×10^{-3}	4.9×10^{-3}	---	---
1,1 DCE	9.0×10^{-3}	1.4×10^{-3}	9.4×10^{-2}	1.6×10^{-1}	1.0×10^{1}	9.0×10^{-3}	1.4×10^{-3}	1.6×10^{-3}	1.6×10^{-1}	1.8×10^{-1}
TCE	---	2.5×10^{-2}	3.5	---	---	---	2.5×10^{-2}	2.8×10^{-2}	---	---
Vinyl Chloride	---	8.1×10^{-5}	2.8×10^{-3}	---	---	---	8.1×10^{-5}	9.0×10^{-5}	---	---
Benzene	---	4.9×10^{-4}	2.1×10^{-2}	---	---	---	4.9×10^{-4}	5.5×10^{-4}	---	---
Tetrachloroethylene	1.0×10^{-2}	1.5×10^{-3}	1.2×10^{-1}	1.5×10^{-1}	1.2×10^{-1}	1.00×10^{-2}	1.5×10^{-3}	1.7×10^{-3}	1.5×10^{-1}	1.7×10^{-1}
Methylene Chloride	6.0×10^{-2}	1.8×10^{-1}	25	3.0	4.2×10^{2}	6.00×10^{-2}	1.8×10^{-1}	2.0×10^{-1}	3.0	3.3
1,1 DCA	1.0	5.2×10^{-3}	3.8×10^{-1}	5.2×10^{-3}	3.8×10^{-1}	1.0×10^{-1}	5.2×10^{-3}	5.8×10^{-3}	5.2×10^{-2}	5.8×10^{-2}
PCP	3.0×10^{-2}	2.1×10^{-4}	9.0×10^{-3}	7.0×10^{-3}	3.0×10^{-1}	3.0×10^{-2}	2.1×10^{-4}	2.4×10^{-4}	7.0×10^{-3}	8.0×10^{-3}
Total				3.3	4.4×10^{2}				3.4	3.7

(1) Total Daily Intake by Ingestion equals ground water ingestion and contaminated soil ingestion.

TABLE E-19
COMPARISON OF SUBCHRONIC DAILY INTAKE (SDI) AND CHRONIC DAILY INTAKE (CDI)
OF NON-CARCINOGENS WITH ACCEPTABLE SUBCHRONIC DAILY INTAKE (AIS)
AND ACCEPTABLE CHRONIC DAILY INTAKE (AIC)
(ADULT RESIDENT)
TOTAL DAILY INTAKE BY INHALATION(1)

Indicator Contaminant	AIS (mg/kg/day)	SDI (mg/kg/day) Best Estimate	SDI (mg/kg/day) Maximum Plausible	SDI:AIS (mg/kg/day) Best Estimate	SDI:AIS (mg/kg/day) Maximum Plausible	AIC (mg/kg/day)	CDI (mg/kg/day) Best Estimate	CDI (mg/kg/day) Maximum Plausible	CDI:AIC Best Estimate	CDI:AIC Maximum Plausible
1,2 DCA	---	2.0×10^{-2}	4.9×10^{-2}	---	---	---	2.2×10^{-4}	5.3×10^{-4}	---	---
1,1 DCE	---	4.3×10^{-3}	1.0×10^{-2}	---	---	---	7.0×10^{-5}	1.7×10^{-4}	---	---
TCE	---	1.7×10^{-1}	3.7×10^{-1}	---	---	---	1.3×10^{-3}	3.0×10^{-3}	---	---
Vinyl Chloride	---	1.3×10^{-4}	3.0×10^{-4}	---	---	---	4.0×10^{-6}	1.0×10^{-5}	---	---
Benzene	---	9.5×10^{-3}	2.3×10^{-3}	---	---	---	2.0×10^{-5}	6.0×10^{-5}	---	---
Tetrachloroethylene	---	5.6×10^{-3}	1.3×10^{-2}	---	---	---	8.0×10^{-5}	1.8×10^{-4}	---	---
Methylene Chloride	9.0×10^{-1}	1.1	2.7	1.2	3.0	9.0×10^{-1}	8.8×10^{-3}	2.1×10^{-2}	9.8×10^{-3}	2.3×10^{-2}
1,1 DCA	1.0	1.7×10^{-2}	4.0×10^{-2}	1.2×10^{-2}	2.9×10^{-2}	1.0×10^{-1}	2.6×10^{-4}	6.2×10^{-4}	2.6×10^{-3}	6.2×10^{-3}
PCP	---	4.1×10^{-4}	9.6×10^{-4}	---	---	---	1.1×10^{-5}	2.5×10^{-5}	---	---
Total(4)				1.2	3.0				1.2×10^{-2}	2.9×10^{-2}

(1) Total Daily Inhalation equals inhalation of vapors while showering and inhalation of fugitive dust.
(4) Totals exceeding 1.00 are considered unacceptable.

TABLE E-20
COMPARISON OF SUBCHRONIC DAILY INTAKE (SDI) OF NON-CARCINOGENS
WITH ACCEPTABLE SUBCHRONIC DAILY INTAKE (AIS)
(CHILDREN)

	TOTAL DAILY INTAKE BY INGESTION					TOTAL DAILY INTAKE BY INHALATION(2)				
	AIS (mg/kg/day)	SDI(mg/kg/day) (mg/kg/day)		SDI:AIS (mg/kg/day)		AIS (mg/kg/day)	SDI (mg/kg/day)		SDI:AIS	
Indicator Contaminant		Best Estimate	Maximum Plausible	Best Estimate	Maximum Plausible		Best Estimate	Maximum Plausible	Best Estimate	Maximum Plausible
1,2 DCA	---	1.0×10^{-2}	9.4×10^{-1}	---	---	---	4.7×10^{-9}	2.0×10^{-7}	---	---
1,1 DCE	9.0×10^{-3}	3.2×10^{-3}	1.9×10^{-1}	3.6×10^{-1}	2.1×10^{1}	---	1.0×10^{-8}	7.2×10^{-7}	---	---
TCE	---	5.7×10^{-2}	7.1	---	---	---	3.1×10^{-7}	2.4×10^{-5}	---	---
Vinyl Chloride	---	1.8×10^{-4}	5.8×10^{-3}	---	---	---	2.4×10^{-9}	1.0×10^{-8}	---	---
Benzene	---	1.1×10^{-3}	4.3×10^{-2}	---	---	---	4.6×10^{-9}	1.6×10^{-7}	---	---
Tetrachloroethylene	1.0×10^{-2}	3.4×10^{-3}	2.5×10^{-1}	3.4×10^{-1}	25	---	8.5×10^{-8}	3.2×10^{-6}	---	---
Methylene Chloride	6.0×10^{-2}	4.0×10^{-1}	51	6.7	850	9.0×10^{-1}	2.3×10^{-6}	1.6×10^{-5}	2.6×10^{-6}	1.8×10^{-5}
1,1 DCA	1.0	1.2×10^{-2}	7.6×10^{-1}	1.2×10^{-2}	7.6×10^{-1}	1.0	5.6×10^{-8}	3.0×10^{-7}	5.6×10^{-8}	3.0×10^{-7}
PCP	3.0×10^{-2}	4.8×10^{-4}	1.8×10^{-2}	1.6×10^{-2}	6.0×10^{-1}	---	4.7×10^{-9}	6.0×10^{-8}	---	---
Total				7.4	897				2.7×10^{-6}	1.8×10^{-5}

TABLE E-21
COMPARISON OF SUBCHRONIC DAILY INTAKE (SDI) OF NON-CARCINOGENS
WITH ACCEPTABLE SUBCHRONIC DAILY INTAKE (AIS)
(CONSTRUCTION WORKER)

	TOTAL DAILY INTAKE BY INGESTION(1)					TOTAL DAILY INTAKE BY INHALATION(2)				
	AIS (mg/kg/day)	SDI(mg/kg/day) (mg/kg/day)		SDI:AIS (mg/kg/day)		AIS (mg/kg/day)	SDI (mg/kg/day)		SDI:AIS	
Indicator Contaminant		Best Estimate	Maximum Plausible	Best Estimate	Maximum Plausible		Best Estimate	Maximum Plausible	Best Estimate	Maximum Plausible
1,2 DCA	---	2.0×10^{-7}	5.0×10^{-7}	---	---	---	3.1×10^{-9}	4.0×10^{-8}	---	---
1,1 DCE	9.0×10^{-3}	4.4×10^{-7}	1.8×10^{-5}	4.9×10^{-5}	2.0×10^{-3}	---	6.8×10^{-9}	1.4×10^{-7}	---	---
TCE	---	1.3×10^{-5}	6.1×10^{-4}	---	---	---	2.0×10^{-7}	4.8×10^{-6}	---	---
Vinyl Chloride	---	1.0×10^{-7}	2.6×10^{-7}	---	---	---	1.6×10^{-9}	2.0×10^{-9}	---	---
Benzene	---	2.0×10^{-7}	4.1×10^{-6}	---	---	---	3.0×10^{-9}	3.2×10^{-8}	---	---
Tetrachloroethylene	1.0×10^{-2}	3.6×10^{-6}	8.2×10^{-5}	3.6×10^{-4}	8.2×10^{-3}	---	5.6×10^{-8}	6.4×10^{-7}	---	---
Methylene Chloride	6.0×10^{-2}	9.6×10^{-5}	4.1×10^{-4}	1.6×10^{-3}	6.8×10^{-3}	9.0×10^{-1}	1.5×10^{-6}	3.2×10^{-6}	1.7×10^{-6}	3.6×10^{-6}
1,1 DCA	1.0	2.4×10^{-6}	7.7×10^{-6}	2.4×10^{-6}	7.7×10^{-6}	1.0	3.7×10^{-8}	6.0×10^{-8}	3.7×10^{-8}	6.0×10^{-8}
PCP	3.0×10^{-2}	2.0×10^{-7}	1.5×10^{-6}	4.0×10^{-8}	3.2×10^{-7}	---	3.1×10^{-9}	1.2×10^{-8}	---	---
Total				2.0×10^{-3}	1.7×10^{-2}				1.7×10^{-6}	3.6×10^{-6}

(1) Total Daily Intake by Ingestion equals contaminated soil ingestion.
(2) Total Daily Intake by Inhalation equals contaminated fugitive dust inhalation.

TABLE E-22
CALCULATION OF LIFETIME CANCER RISK
(ADULT RESIDENT)

Indicator Contaminant	TOTAL DAILY INTAKE BY INGESTION(1) CDI (mg/kg/day) Best Estimate	CDI (mg/kg/day) Maximum Plausible	Carcinogenic Potency Factor $(mg/kg/day)^{-1}$	Lifetime Cancer Risk Best Estimate	Lifetime Cancer Risk Maximum Plausible	TOTAL INHALATION(2) CDI (mg/kg/day) Best Estimate	CDI (mg/kg/day) Maximum Plausible	Carcingocenic Potency Factor $(mg/kg/day)^{-1}$	Lifetime Cancer Risk Best Estimate	Lifetime Cancer Risk Maximum Plausible
1,2 DCA	4.4×10^{-3}	4.9×10^{-3}	9.10×10^{-2}	4.0×10^{-4}	4.5×10^{-4}	2.2×10^{-5}	5.3×10^{-4}	9.1×10^{-2}	2.0×10^{-6}	4.8×10^{-5}
1,1 DCE	1.4×10^{-3}	1.6×10^{-3}	5.80×10^{-1}	8.4×10^{-4}	9.6×10^{-4}	7.0×10^{-5}	1.7×10^{-4}	1.2	8.4×10^{-5}	2.0×10^{-4}
TCE	2.5×10^{-2}	2.8×10^{-2}	1.10×10^{-2}	2.8×10^{-4}	3.1×10^{-4}	1.3×10^{-3}	3.0×10^{-3}	1.3×10^{-2}	1.7×10^{-5}	3.9×10^{-5}
Vinyl Chloride	8.1×10^{-5}	9.0×10^{-5}	2.30	1.9×10^{-4}	2.1×10^{-4}	4.0×10^{-6}	1.0×10^{-5}	3.0×10^{-1}	1.2×10^{-6}	3.0×10^{-6}
Benzene	4.9×10^{-4}	5.5×10^{-4}	5.20×10^{-2}	1.4×10^{-5}	1.6×10^{-5}	2.0×10^{-5}	6.0×10^{-5}	2.9×10^{-2}	5.8×10^{-7}	1.7×10^{-6}
Tetrachloroethylene	1.5×10^{-3}	1.7×10^{-3}	5.10×10^{-2}	7.7×10^{-5}	8.7×10^{-5}	8.0×10^{-5}	1.8×10^{-4}	3.3×10^{-3}	2.6×10^{-7}	5.9×10^{-7}
Methylene Chloride	1.8×10^{-1}	2.0×10^{-1}	7.50×10^{-3}	1.4×10^{-3}	1.5×10^{-3}	8.8×10^{-3}	2.1×10^{-2}	1.4×10^{-2}	1.2×10^{-4}	2.9×10^{-4}
1,1 DCA	5.2×10^{-3}	5.8×10^{-3}	9.1×10^{-2}	4.7×10^{-4}	5.3×10^{-4}	2.6×10^{-4}	6.2×10^{-4}	9.1×10^{-2}	2.4×10^{-4}	5.6×10^{-5}
PCP	2.1×10^{-4}	2.4×10^{-4}	1.6×10^{-2}	3.3×10^{-6}	3.8×10^{-6}	1.1×10^{-5}	2.5×10^{-5}	---	---	---
Total	---	---	---	3.7×10^{-3}	4.1×10^{-3}	---	---	---	2.5×10^{-4}	6.4×10^{-4}

(1) Total Daily Intake by ingestion equals ground water ingestion and contaminated soil ingestion.
(2) Total Daily Intake by inhalation equals water vapor inhalation and contaminated fugituve dust inhalation.